The Indian App Ecosystem

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Abstract

The growth of locally relevant apps in India has been sluggish due to weak network infrastructure and the limited availability of domestic app distribution platforms that offer competitive revenue shares to independent developers. As a result, a significant proportion of Indian app developers focus on catering to the international and Indian metropolitan app markets rather than creating localised apps that meet the needs of semi-urban and rural India.

To promote the growth of locally relevant apps, the government can act as an enabler especially in the pursuance of socio-economic development and inclusive growth in realms that include but are not limited to, healthcare, education, agriculture, finance and governance.

However, to promote the holistic development of the app economy, Indian developers will need to focus more on user interface design as well as business model innovation. The market must realize the latent potential of uniquely Indian apps. This potential, in turn, can be unlocked if and only if network coverage increases, smartphone penetration continues to rise and the 'absorptive capacity' of the Indian population towards new technology grows through schemes that promote digital awareness and literacy. Without these preliminary conditions, the user base of the Indian app economy will remain short of its true potential.

All major players have a role to play in achieving the growth of locally relevant content. Telecom operators have an imperative to increase 3G deployment or leapfrog into newer generation technologies. Original equipment manufacturers and app developers must collaborate to create and ensure that locally relevant apps can run on a variety of mobile devices sold across India. The Government and Reserve Bank of India must ensure that the policy framework is favourable by re-evaluating telecom regulation and mobile-payment policies, respectively.

In short, app developers, distributers, the government, device manufacturers, operating system companies and other stakeholders must work together to ensure that India's app economy continues upon its upward growth trajectory such that the needs of Indians at the Bottom of the Pyramid are addressed and international competitiveness is reached.

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Executive Summary

India is characterised by a high service deficit that Information and Communications Technology (ICT) can potentially ameliorate. Access and inclusion to basic services that include, *inter alia*, healthcare, education, agricultural information and finance are necessary to uplift disadvantaged Indians out of poverty and empower them into being economically self-sufficient agents. Given that India's teledensity is 73 percent and that mobile telephony is the one technology that has reached almost all income strata, there is potential to use India's mobile backbone to cater to a host of currently unmet demands.

The app economy becomes important in this regard as apps are a convenient way to deliver information and services to not only individual users but also to government agencies and business enterprises. The app economy also gains significance when smartphone sales are rapidly rising, as is the case in urban India. Apps are intuitive to use due to their single-purpose nature and are often less-data intensive than internet sites. It is widely acknowledged that India is now at the threshold of entering the second phase of its telecommunications revolution which is centred on content. India's connectivity should be exploited to deliver content that mitigates informational asymmetries, helps contract formation and enforcement, and empowers the lives of its citizenry as well as eases the operations of its government agencies and business enterprises.

Apps have the potential to achieve the abovementioned goals but for the Indian app economy to take-off, several prerequisites need to be in place. This paper systematically evaluates the opportunities and challenges that exist within the Indian app ecosystem by creating a framework that outlines its principal activities, key stakeholders and ecosystem dependencies. App development, distribution and demand are the three core aspects identified in the app economy and their growth depends on the network infrastructure, policy framework, operating system landscape, consumer devices and prevailing socio-economic conditions (which include digital literacy and awareness).

As far as app development in India is concerned, the two main issues are weak user interface design and the lack of locally relevant content. For the former, Indian app developers need to ensure that their apps have an interface which is intuitive, visually appealing, high on

functionality and minimalistic. To achieve this, it is recommended that app developer teams in India have employees who come from a mix of backgrounds that span from software engineers to design professionals and psychologists such that an in-depth understanding of visual aesthetics and user behaviour is achieved.

Regarding the issue of locally relevant content, while many apps have emerged in the domain of Bollywood entertainment, cricket and devotional music, there is much that is left to be desired in terms of diversifying this content into regional languages and expanding it into the domain of *mobile for development* (M4D) whereby apps address the unique socio-political and economic needs of the Indian citizenry. To enable this, network coverage and capability must be improved within the interiors of the country where the demand for highly localised apps is greater. Furthermore, app developers will need to collaborate with original equipment manufacturers (OEMs) to ensure that localised apps, which may require hardware support for Indic scripts, function well across a variety of devices and are disseminated adequately across the country. Telecom operators may also have a role to play, provided they offer competitive revenue shares to app developers, in facilitating mobile payments since they cater to a large prepaid segment. All parties will benefit from ensuring that the penetration of apps is achieved across India as data consumption will drive revenue for both app developers and telecom operators and will help OEMs boost sales. Since the market for highly localised apps is nascent, the government can play a decisive role in developing the sector by offering technical and monetary support to apps developers and distributors who are designing and disseminating apps that serve a public good.

This needs to be complemented with business model innovation on the app distribution side. Currently, the most popular app distribution platforms in India are Android's GooglePlay and Apple's App Store. These are international app stores which do not lend themselves to the easy discovery of highly India-specific/regional content. While some Indian telecom operator managed app stores did emerge around 2010, they did not offer standardized revenue sharing contracts to developers. Under this arrangement, developers would often get as little as 30 percent of the total revenue. This led most Indian developers to turn to international app stores which offered, in contrast, 70 percent of the total revenue generated by the app to developers. To fuel the growth of locally relevant content, it is necessary that there are Indian app distribution platforms that follow a revenue sharing model which is globally competitive. These app distribution platforms should also be able to operate across multiple mobile devices.

An example of a successful Indian app distribution platform is AppsDaily which sells its own apps through physical outlets that are located across 140 cities in India. AppsDaily has gained immense popularity as it is addressing the current gap in the market in terms of delivering localised content and is also circumventing unfavourable mobile-payment regulation by allowing payments in cash. Moreover, by having stores with a physical attendant, AppsDaily has made the process of obtaining apps far easier for those who are less digitally literate or aware. 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.

Finally, one must also focus on unlocking the latent demand for apps by increasing user awareness and digital literacy. People must be made aware of all the services that apps can deliver. Some of these include connecting buyers to sellers, doctors to patients, teachers to students etc. and the storage of data (e.g. enterprises can keep a tab on their inventories or government agencies can digitalize their files). Apps can also facilitate the crowdsourcing of data such that app users across the country can anonymously report, for example, vegetable prices. These services can have far-reaching economic implications in terms of improving the ease of doing business or delivering access to critical services to marginalised groups. It is imperative that users are made aware of this not only through public educational schemes but also private initiatives aimed at increasing digital literacy. On the social side, a particular issue that India is grappling with is the immense gender skew in terms of smartphone usage, and technology at large. This is something that civil society organisations and other key stakeholders must address as women represent a large proportion of the current untapped demand.

It is necessary that the overarching policy environment supports the growth of app development, distribution and demand. Regarding app development, a particular issue that many developers cite is the lack of seed funding and innovation incubation. App developers engaging in the risky area of *mobile for development* feel the need for more monetary and technical support, as well as the opportunity to collaborate with bodies such as educational and healthcare institutions. Government initiatives such as the India Inclusive Innovation Fund are welcome but the magnitude of the problem suggests that a major barrier to entrepreneurial activity is the lack of social security nets in the country. This substantially increases the risk levels of engaging in truly innovative activity as failure may imply a drop in the standard of living. On the app distribution side, if the Reserve Bank of India eases its mobile-payment regulation whilst not compromising

on security, it would be considerably easier for users to purchase apps. It is also necessary that app distribution is supported by the concurrent growth of network infrastructure, which is possible if spectrum policy and telecom regulation are re-examined. Spectrum policy must be targeted towards increasing efficiency by offering contiguous spectrum to commercial players by re-farming from defence, outlining a clear exit policy for inefficient, incumbent telecom operators and having an optimum mergers and acquisition policy in the telecom sector. Taxation on spectrum usage should also decrease as this limits the ability of telecom operators to expand the deployment of newer generation technologies across the country. Finally, the 'absorptive capacity' of the Indian population towards the adoption and usage of apps must be increased through schemes that promote digital literacy and awareness.

To truly move forward, the Indian app ecosystem must start acknowledging its pivotal role and focus not only on gaining international competitiveness through improved user interface design but also on catering to the 1.3 billion citizens that reside within India. The market gap in terms of delivering localised content is large and innovation which addresses the unique socio-political and economic needs of India is likely to meet with significant success. In this regard, many have said that India can not only benefit from local app distribution platforms but also from local operating systems. It is likely that many of these local innovations could also benefit other developing countries that face similar challenges and are looking at apps as a means to address their service deficits. This would complement India's outward oriented focus and create a space for apps that move beyond the paradigm of *mobile for entertainment* to *mobile for development.*

The key to make this happen is to bring market agents together in a collaborative spirit and for the government to provide the necessary support till the Indian app economy is sufficiently mature to take-off independently.

List of Abbreviations

App = Mobile Software Application

API = Application Programming Interface

BoP = Bottom of the Pyramid

ICT = Information and Communications Technology

ICT4D = ICT for Development

M4D = Mobile for Development

MVAS = Mobile Value Added Service

OEM = original equipment manufacturer

OS = Operating System

SMS = Short Message Services

Telco = Telecom Operator

Telecom = Telecommunications

USD = United States' Dollar

USSD = Unstructured Supplementary Service Data

2G = Second Generation

3G = Third Generation

4G = Fourth Generation

1. Introduction

Mobile software applications (apps) are bite-sized software programs that are designed to fulfil a particular purpose which can fall within the ambit of; *inter alia*, gaming, education, entertainment, healthcare, networking, governance and navigation. In developing countries there are many 'mobile applications' that are Short Message Service (SMS) or Unstructured Supplementary Service Data (USSD) based.[1] For the purpose of this study, these will not be considered as apps and will instead be treated as network services.[2] Apps represent more complex software packages that either use wireless networks on a one-off basis (to download, for example) or continuously to deliver information and services.[3] Apps typically operate on smartphones and tablets (although there are some which also function on high-end feature phones).

The mobile software application economy (also known has the 'app economy') came into existence primarily due to Apple's innovation. In June 2007, Apple launched the iPhone and a year later it introduced the App Store which was a revolutionary concept because it was one of the first commercially successful platforms that aggregated and distributed apps. Instead of cherry-picking a set of designated app programmers for the iPhone, Apple allowed any developer from the public domain to submit an app for consideration on its app atore. While free apps continue to outnumber the paid ones both in sheer number and downloads, for the paid apps or those which generate revenue through advertising, in-app purchases etc., Apple offeres a flat 70 percent of the revenue to the developer and retains the remaining 30 percent. This business model innovation broke the 'walled garden' through which network operators controlled the mobile ecosystem. (Content could now be delivered through Wi-Fi and internet-based aggregation platforms rather than solely through the telecom operator network). The iPhone surged in popularity and by October 2008, Apple had seen two billion app downloads[4] thanks to the plethora of apps that were designed for it. This marked the beginning of the app economy and

[1] In India SMS-based service include railway bookings and USSD-based services include banking. These are relatively rudimentary when compared to applications that use the internet.
[2] Ibid.
[3] Ibid.
[4] Apple, Press Release, 2008.

Apple's competitors which include Google, Nokia, Research in Motion and Microsoft launched their respective app stores.

Almost six years later, due the range and diversity of services that apps can deliver, the global app economy is of indisputable significance and caters to the needs of consumers, enterprises and government agencies. According to Gartner, the app economy will accumulate 26 billion USD in global revenue by the end of 2013 (a 44 percent increase from 2012) and will attract 102 billion downloads.[5] The economic impact of the app economy has been significant, with the sector creating 519,000 jobs in the United States of America.[6] The app economy is thus, a burgeoning sector which has the potential to increase internet adoption, act as a socio-economic leveller and create jobs.[7]

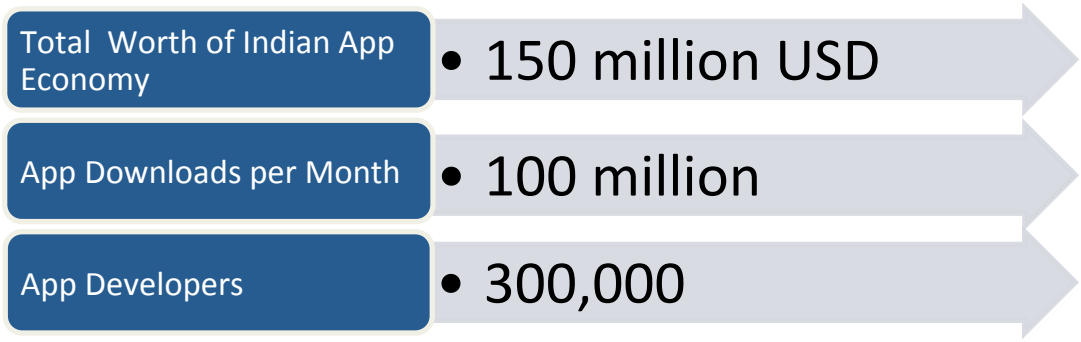
In the context of India, with the growing ubiquity and increasing affordability of mobile devices, apps can play a role in enhancing service delivery. India's teledensity is 73 percent and is expected to reach 100 percent by the end of 2015.[8] This is indicative of the fact that mobile phones have penetrated regions where conventional infrastructure is lacking. This puts India in a position to leverage its mobile infrastructure to provide services such as banking, education and agricultural advice in regions where there is a paucity of such services. It is well known that in emerging markets the growth dividend from ICT development is high as technology can facilitate access and inclusion by delivering services to some of the most marginalised groups.[9] The trickle-down effect from growth is only possible if all segments of the population are included.

Due to the presence of potential scale, skill, demand and growth, India's app economy has a promising future. India is the second largest telecom network in the world, has a large base of skilled IT professionals and is a 'mobile first' economy i.e. an economy where the majority of the citizenry accesses the internet via a mobile device. India's app economy shows robust signs

[5] Gartner report cited at: "Making money in the free app economy." *Business Standard*. 4 Nov. 2013. Web. 20 Jan. 2014. <http://www.business-standard.com/article/management/making-money-in-the-free-app-economy-113110300460_1.html>. and "Global mobile app download revenue to touch $26 bn in 2013: Gartner." *The Financial Express*. 19 Sept. 2013. Web. 20 Jan. 2014. <http://www.financialexpress.com/news/global-mobile-app-download-revenue-to-touch-26-bn-in-2013-gartner/1171341>.
[6] Mandel , Michael , and Judith Scherer. "The Geography of the App Economy." *CTIA: The Wireless Association*. (2012): Web. 20 Jan. 2014. <http://files.ctia.org/pdf/The_Geography_of_the_App_Economy.pdf>.
[7] Ibid.
[8] TRAI projections
[9] Kathuria, Rajat; Kedia-Jaju, Mansi. India: The Impact of Internet**.** IAMAI, Department of Information Technology, Government of India and ICRIER, 2011.

as the country experiences 100 million apps downloads every month[10]and already has an estimated 300,000 app developers.[11] India's app economy is also estimated to be worth 150 million USD as per 2012 data.[12] Nevertheless, India's app economy is not performing up to potential as reflected by the sluggish growth of locally relevant apps.

Figure 1: Indian App Economy Statistics



A number of factors are at play. Some of these are ecosystem constraints which include low network coverage, broadband penetration and financial exclusion (which inhibits the ability of users to pay for apps). Others are supply-side issues which include challenges faced by app-developers such as unfavourable and ad-hoc domestic revenue sharing models,[13] mobile device fragmentation and design and discoverability problems. At the user-end, demand-side challenges which encapsulate market frictions in the form of lack of digital awareness and low literacy rates constrain the potential consumer-base of the app economy.

The study develops an analytical framework which gives a bird's eye view of the core functionalities of the app economy, its stakeholders and supporting ecosystem. This framework is used to understand the incentives and linkages between different stakeholders and their relationship/dependency on the external factors that include the policy environment, network infrastructure, socio-economic conditions, consumer devices and the operating system landscape.

[10] Law, Abhishek. "Developing India's app market." *The Hindu* [New Delhi] 1 Aug. 2012: *The Hindu Business Line*. Web. 20 Jan. 2014.
[11] "IAMAI launches Apps Foundation for developers." *The Times of India* [New Delhi] 26 June 2013: Print.
[12] Law, Abhishek. "Developing India's app market." *The Hindu* [New Delhi] 1 Aug. 2012: *The Hindu Business Line*. Web. 20 Jan. 2014.
[13] TRAI Recommendation 2008: http://www.trai.gov.in/WriteReadData/Recommendation/Documents/AS140512.pdf

With the aid of primary and secondary data (exhibit 1, appendix), this framework is used to contextualize the challenges and opportunities faced by the Indian app economy and deduce a way forward to encourage its growth such that the sector is internationally competitive and addresses key local developmental issues.

The rest of this paper is organised as follows: section II describes the anatomy of the app economy, presents this paper's core framework and highlights the economic rationale behind apps; section III underscores the challenges in India's app ecosystem; section IV details app-developer and distributor side issues; section V highlights the user-end issues and finally, section VI concludes with the way forward**.**

2. The Anatomy of the App Economy

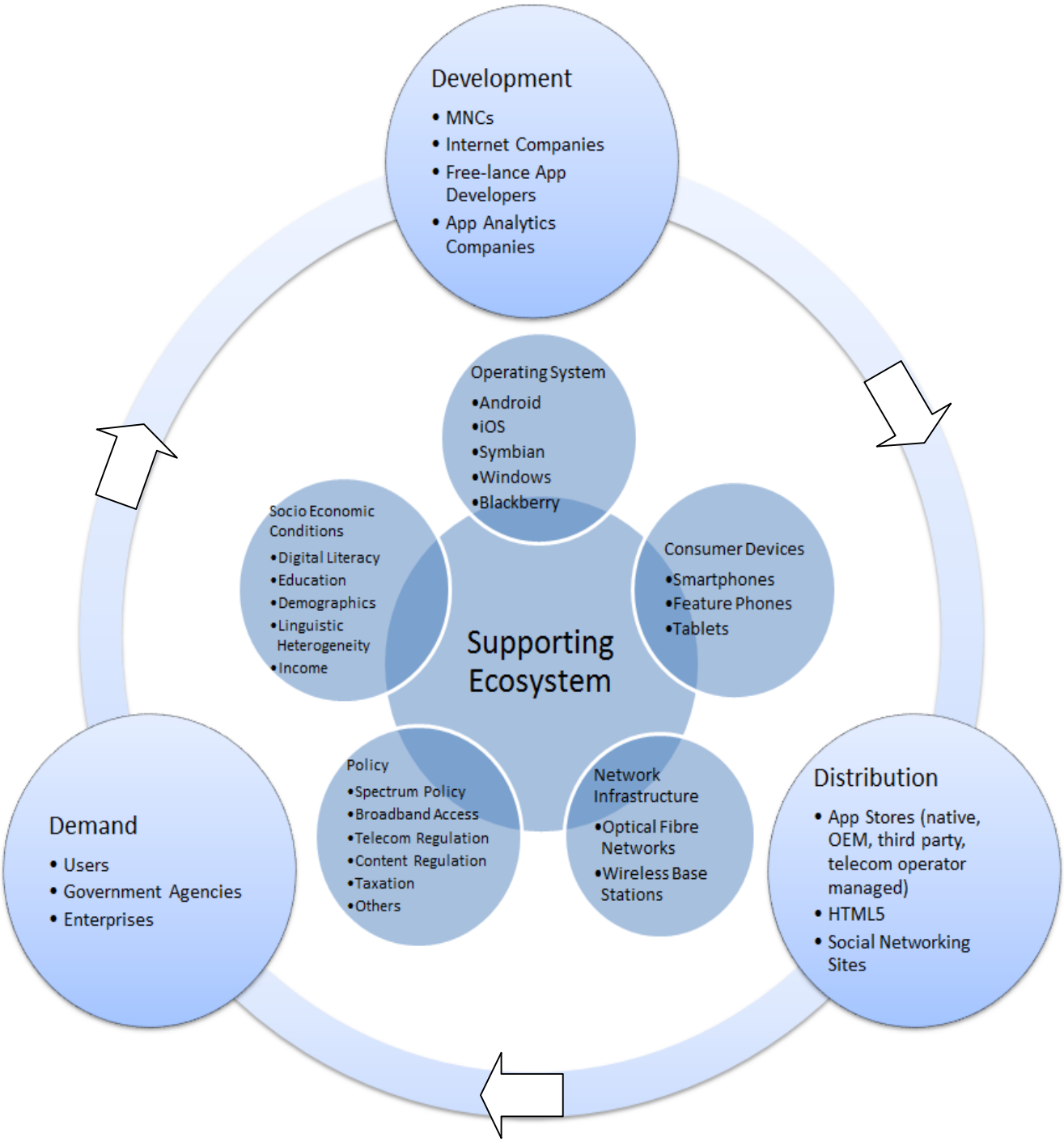
2.1 The App Ecosystem

As this paper's core framework demonstrates (figure 2), the app economy comprises of three primary activities: app development, distribution and demand (represented by the outer circle). These activities in turn, depend on a complex supporting ecosystem whose components are the operating system (OS) landscape, consumer devices, network infrastructure, the policy environment and prevailing socio-economic conditions (represented by the inner circles).

The core participants around whom the app economy revolves are the app developers, distributors and consumers. These agents are directly involved in the life-cycle of an app. App developers vary significantly in size and form and include, *inter alia*, freelance software developers, multinational corporations, internet companies such as Google, and app analytics companies. Developers distribute and sell apps through content aggregating media such as app stores, HTML5 and social networking sites. App stores are the primary medium of interface between developers and consumers with transactions and communications often occurring via and facilitated by the app store. App stores can be native i.e. specific to the operating system (e.g. Apple's App Store*)*, third-party (e.g. GetJar and Crackberry*)*, OEM-specific (e.g. Samsung Apps) or telecom-operator managed (e.g. Aircel's App Store).[14] At the user-end, the demand and consumption of apps is driven by individual mobile device users, commercial enterprises and government agencies. Consumers complete the cycle of an app by providing feedback through rating systems inbuilt within app stores and by generating revenue for app developers and distributors.

[14] App distribution may sometimes occur via direct developer to client channels in which case the app is usually tailor-made for a commercial enterprise, although this is not common.

Figure 2: The App Economy's 3D Framework & Ecosystem



Source: Made by the authors

The scalability of the app economy's principal activities depends on the soundness of the supporting ecosystem. Five main aspects of the ecosystem will now be highlighted, in brief, as per this paper's framework. Solutions to issues highlighted here will be covered in the subsequent sections.

2.1.1 The Operating System

The mobile OS constitutes the software-hosting platform atop which apps operate. Despite the large variety in mobile hardware vendors, the mobile software space is relatively concentrated with just a small number of players, where Google's Android and Apple's iOS currently have the widest global reach.[15] While most mobile OS platforms are comparable in terms of the kind of apps they can support, they have different technical and legal implications for app developers, distributors and consumers.

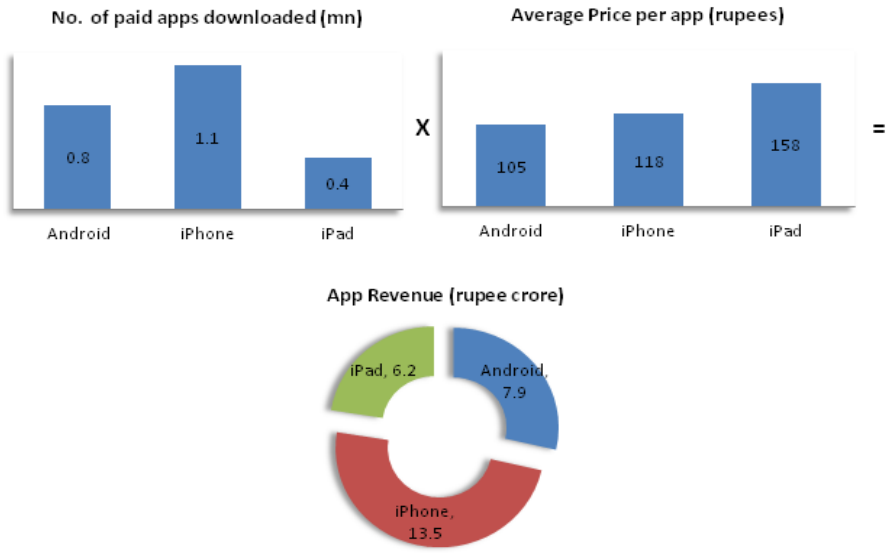
An important difference between OS platforms is whether they belong to a closed or open ecosystem. Operating systems like Android[16] are open source and thus allow multiple OEMs to build devices that use their OS, permit the existence of third party app stores, and let app developers use their software development kit (SDK) for free as well as upload apps easily. On the other hand, a closed operating system like iOS permits only Apple devices to use the iOS, has a dedicated app store,[17] charges a fee for using its SDK and has a screening process before accepting apps. For developers, the choice of OS platform is determined by a variety of considerations with an important factor being user reach. It is common, however, for app developers to create apps for multiple OS platforms. For distributors, the OS impacts exclusivity and for the consumer, the OS may result in a mild 'lock-in'; whereby the user is reluctant to switch to another OS due to the investment that has gone into learning the current OS's functionality and the sunk costs associated with downloading apps. The incidence and severity of 'lock-ins' has greatly diminished over time and the phenomenon typically occurs for Apple where there are significant benefits from owning multiple Apple devices.

In India, the OS landscape is dominated by Android primarily because the Android OS is allowed to run on multiple devices including those that cater to lower income strata. Despite

15 Llamas, Ramon, Ryan Reith, and Michael Shirer. Android Pushes Past 80% Market Share While Windows Phone Shipments Leap 156.0% Year Over Year in the Third Quarter. IDC, 12 Nov 2013. Web. 13 Feb 2014.
16 Although technically, Android is termed as partially-open/closed. See: http://seekingalpha.com/article/2027211-in-the-real-world-android-is-a-proprietary-platform
17 Although it is possible to obtain third party app stores by 'jailbreaking' the device.

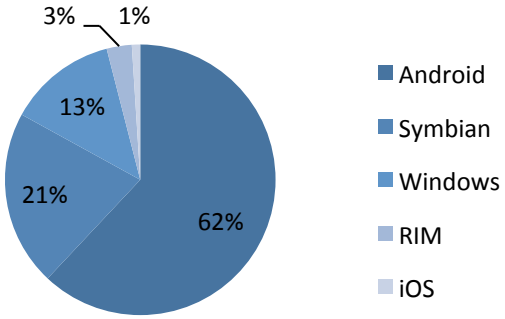
having the widest reach, the Android OS's app store, GooglePlay, only generates 29 percent of the total app revenue in India (figure 3).[18] Most of the rest comes from Apple's App Store which is expected as Apple caters to the high income segment. A snapshot of the smartphone OS share in India is shown below in figure 4.[19]

Figure 3: Revenue of Google Play Store and Apple App Store in India (October 2012)



Source: XYO Logic, Avendus Estimates

Figure 4: Operating System Landscape in India



Source: Nielsen Informate Mobile Insights, Share of Purchases for India, Fieldwork: Sept-Oct. 2012

2.1.2 Consumer Devices

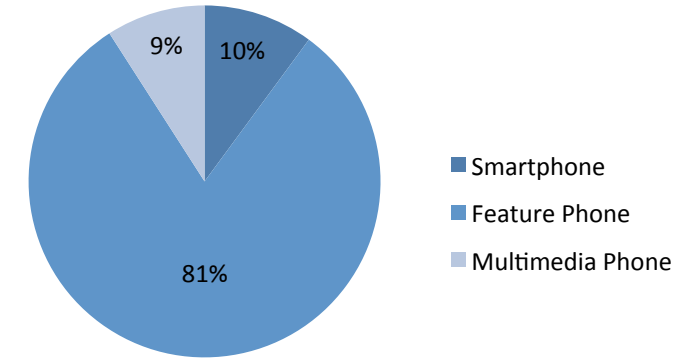
[18] XYO Logic & Avendus Estimates
[19] This only provides ballpark figures as the sample size of this study was 10,000 (users were surveyed in September and October 2012 across 46 Indian cities).

Consumer devices represent the hardware platforms atop which apps are hosted. High penetration of sophisticated consumer devices is favourable as it augments the functional potential of apps. Smartphones and tablets with their computational power and multiple hardware components (including touchscreens, cameras, accelerometers, gyroscopes and 2G/3G/4G readiness etc.) allow for the creation of complex apps that can be rich in multimedia content and carry sophisticated user interfaces. Smartphones and tablets also lend themselves towards a paradigm of usage in which enhancing capability through the addition of new apps (other than pre-included 'stock' apps) is essential to deriving maximum value. This is in contrast to 'feature phones' where the idea of augmenting the device through additional apps is not as prevalent or 'basic phones' where it is non-existent (exhibit 2 in the appendix details types of mobile device and their respective capabilities).

Apps must be designed to operate reliably within the boundaries set by the consumer hardware's abilities. This links in with the choice of operating system. For example, uniformity in design and capabilities across devices running the Apple or Blackberry OS which belong to closed ecosystems, makes it easier for developers to predict how apps will perform across majority of the usage scenarios, while large variation across devices running the Android OS make such prediction more challenging. Device fragmentation across an OS creates interoperability issues for app developers.

In developing countries, there is a trifurcation of consumer devices predicated on income distribution. In India while the 'democratisation of devices' is occurring due to the fact that lower smartphone prices are driving adoption at a fast rate, there is still a clearly distinguishable low- and high-end segment as well as a 'transition group', which represents the emerging middle class who is switching from feature phones to more advanced multimedia devices (these fall in between feature phones and smartphones in terms of capabilities). Figure 5 shows the current penetration of types of phones in India.

Figure 5: Mobile Phone Usage by Type of Phone in India



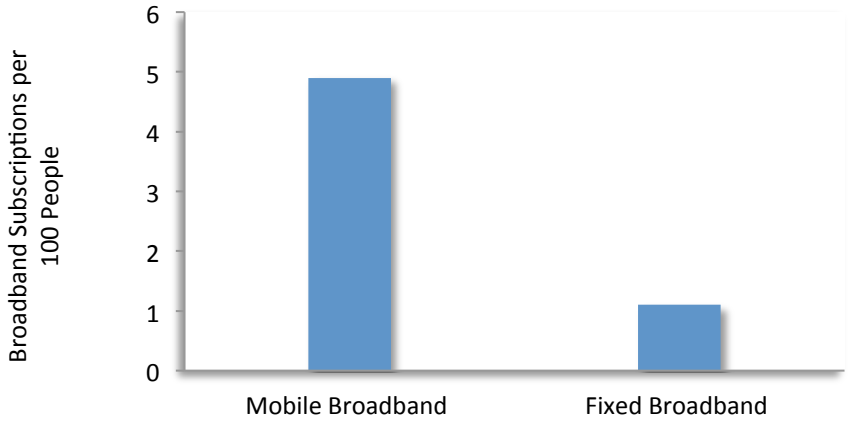
Source: Nielsen Mobile Insights (2012)

2.1.3 Network Infrastructure

Since the app economy is driven by data, factors affecting the availability, accessibility and the affordability of mobile data packages have a significant impact on the app economy's ability to attain scale. Network infrastructure, inclusive of the deployment of 3G, 4G, wireless base stations and optical fibre networks, plays a fundamental role in determining the reach of the app economy. It has a bearing on the demographic of the app economy's consumer base which in turn affects the types of apps demanded and created. Network coverage and capability also impact the permissible richness/data-intensiveness of apps. If a country's network infrastructure is weak, the penetration of apps and their user-experience is negatively affected. India, despite achieving immense voice coverage, has weak network infrastructure in terms of data (figure 6).[20] This has been recognized as a potential barrier to the expansion of its app economy[21] and will be discussed in greater depth in the following sections.

[20] "The App Gap Index." The *Economist Intelligence Unit*. (2013).
[21] Ibid.

Figure 6: Broadband Penetration in India[22]



Source: International Telecommunications Union (2012)

2.1.4 Policy and Regulation

Although the app economy, by virtue of being a subset of the ICT space, is borderless in many respects, it is still subject to the domestic policy framework. App developers and app stores have to adhere to local content and mobile payment regulations. Additionally, domestic policies in the area of spectrum management have a bearing on mobile data availability and affordability and, consequently, affect the adoption and consumption of apps by users. Regulation in the area of telecom, finance and content significantly impacts app development, distribution and demand. India's policy environment is a mixed bag and there are some clear areas for improvement of which one important area for the app economy is mobile-payment regulation. For example, certain regulations make it difficult to store credit/debit card details and passwords that would enable one-touch payments. Additionally, fully functional 'mobile wallets' have not taken-off as it is necessary that such schemes are done through existing bank accounts.[23]

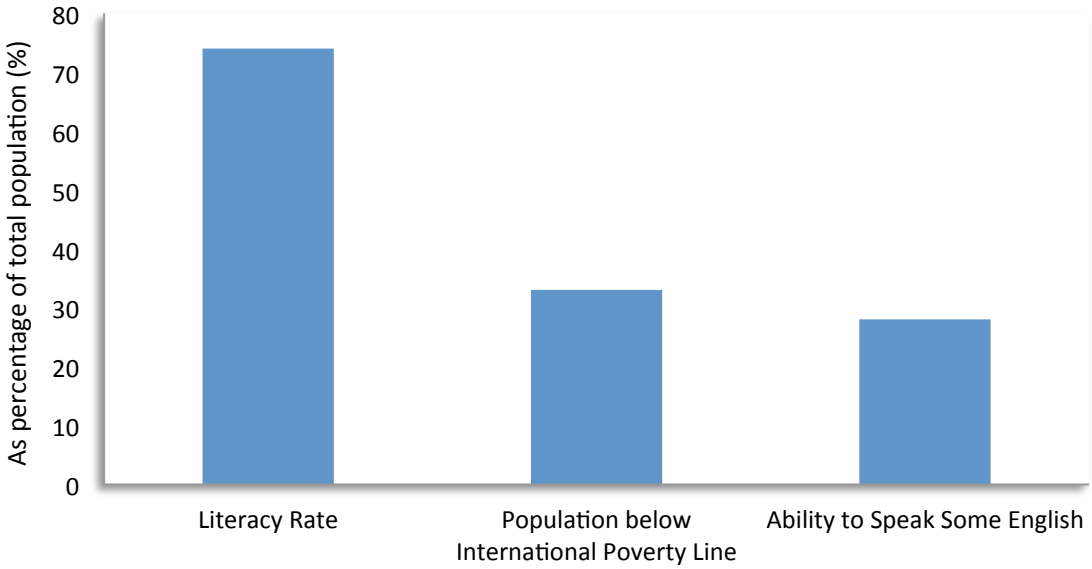
2.1.5 Socio-Economic Conditions

The final element of the app economy's supporting ecosystem is the socio-economic context. The demand and adoption of apps is a consequence of the 'absorptive capacity' of potential users. This is affected by a variety of socio-economic factors including demographics, education, literacy, digital literacy, awareness and income levels. For example, income plays a major part in

[22] The definition of broadband in India was reclassified to 512 kbps from 256 kbps. However, this data reflects the earlier definition as such; estimates should be even lower as per the new definition.
[23] Crabtree, James. 'Reserve Bank of India moves to enhance mobile payments market' *The Financial Times* [Mumbai] 16 Jan. 2014: Web. 20 Jan. 2014.Airtel Money is an initiative in this area.

a user simply being able to afford a smartphone or tablet. The price point for the mass uptake of smartphones in India is estimated to be Rs. 2700.[24] Other factors including, the gender skew in smartphone usage, awareness and working knowledge of English materially affect the ability of a consumer to discover, access and use apps (indicatively, 83% of users operate their phones in English[25]). India's position on select socio-economic indicators is highlighted in figure 7.

Figure 7: Socio Economic Conditions in India



Source: Literacy Rate (2011 Census), Population below Poverty Line (World Bank 2010), Ability to Speak English (India Human Development Survey, 2005)

2.2 Market Structure

24 ICRIER Consultations – figure based on Google estimates.
25 Harlalka, Bikash. "India Mobile Landscape 2013 Topline." Telecom Watch, Web. 13 Feb 2014.

The app economy is characterised by knowledge-intensive production; uncertainty, in the form of technological and market developments; and relatively low levels of initial investment thanks to, *inter alia*, the availability of open source software development tools.[26] At the level of the app developer, the app economy represents monopolistic competition as it has many potential entrants, high levels of competition but also provides adequate space to differentiate products. On the level of app distribution platforms, the market structure is characterised by the dominance of a handful of app stores of which, Android's Google Play and Apple's App Store have the largest reach. The app economy's particularly distinguishing characteristic is that free apps account for nearly 90 percent of total mobile app store downloads indicating that a minority of paid apps drive global revenue.[27] However, it must be noted that all apps are not designed to generate revenue; some apps, particularly those belonging to the enterprise segment, simply represent an extended method of service delivery or marketing (see exhibit 3, appendix).[28] Since app users tend to have highly price elastic demand,[29] monetisation in the app economy is challenging and has taken on subtler forms such as advertising, in-app purchases (whereby users can pay for extra features or additional products) and the freemium model (which allows users to access basic features for free but charges for premium services). Monetisation challenges are exacerbated in the Indian context due to high price-sensitivity, low credit and debit card penetration, and unfavourable mobile-payment regulation which limit app purchases.

2.3 The Economic Rationale behind Apps

Mobile telephony is the one technology that is widely accessible to large segments of the population (including those at the BoP).[30] Countries with high service deficits in areas such as education, healthcare and governance have a gap that can be filled by mobile broadband services.[31] There is therefore, a strong economic rationale to nurture and promote the growth of the app economy in India. The app economy has the potential to be an enabler in reducing informational asymmetries, lowering transaction costs and altering landscape of contract

[26] The level of investment is a positive function of the intended complexity of the app.
[27] Pettey, Christy , and Rob van der Meulen. "Gartner Says Free Apps Will Account for Nearly 90 Percent of Total Mobile App Store Downloads in 2012."*Newsroom*. Gartner, 11 Sept 2012. Web. 13 Feb 2014.
[28] For example, the Make My Trip app.
[29] ICRIER's in-house survey reveals that app developers perceive their users to have a strong preference for free apps.
[30] "Scaling Mobile for Development: A developing world opportunity (Interim Report)." *GSMA Mobile for Development Intelligence*. (2013) Web. 20 Jan. 2014. <https://mobiledevelopmentintelligence.com
[31] "The App Gap Index." The *Economist Intelligence Unit*. (2013).

formation and enforcement. A few examples will be used to elucidate the economic potential of apps.

2.3.1 Mitigating Informational Asymmetries

The app economy can play a key role in mitigating informational asymmetries and reducing market frictions. A case in point is the virility of a Chinese app named BaoGZ which displays the salaries of different jobs. By allowing users to anonymously post their annual earnings along with other relevant job-related information, BaoGZ has become extremely popular and has reduced informational asymmetries in the labour market. It currently offers information on 200,000 companies and 13 million job posts.[32] Its anonymous review system means that its information base is constantly growing. This is similar to the international app, Glassdoor which offers company reviews in English, German and Spanish, and the Indian app, Babajob. The surge in apps dedicated to providing reviews has grown not only in the context of the labour market but also for the restaurant business (Zomato) and the travel sector (TripAdvisor). Users are regularly rating companies, restaurants and hotels such that service delivery is constantly under check.

2.3.2 Reducing Transaction Costs

Mobile data technology at large has been revolutionary because it has radically minimised handling costs by allowing the rapid transfer of data over the internet. By allowing remote access and control, markets can be formed without having to physically move. M-PESA, a mobile payments scheme used by two-thirds of the adult population of Kenya,[33] has significantly reduced the costs of remittance. This in turn has reduced the average interest rate on microfinance loans thereby enabling the growth of microfinance in Kenya.[34] According to GSMA Mobile for Development, this scheme has had significant spill-over effects as it has increased financial inclusion, allowed the growth of more start-ups and resulted in a sister scheme called M-KOPA whereby digital payments made via M-PESA can be used to purchase solar energy.[35] The disruptive macroeconomic effect of this mobile value added service (MVAS)

32 "App showing salaries of different jobs goes viral in China." *WantChinaTimes* [Beijing] 4 Dec. 2013: n. pag.*WantChinaTimes.com*. Web. 13 Feb. 2014.
33 "Why does Kenya lead the world in mobile money?." *The Economist*. 27 May 2013. Web. 13 Feb. 2014.
34 Ibid.
35 "MDI Case Study - M-KOPA." *GSMA Mobile for Development Intelligence*. Web. 20 Jan. 2014.

is easy to see and it is likely that by way of extension, apps could also lower transaction costs and have a similar impact.

2.3.3 Altering Contract Formation and Enforcement

Apps, if interpreted in the broader sense, are bite-sized software packages which can operate on any mobile platform. The Barclays Cycle Hire scheme launched in 2010 in London is the largest public sharing initiative of its type. 10,000 bicycles are publically available on a pay-by-use basis for the inhabitants of London. With the help of a mobile software system or an 'app', the users of these bicycles are tracked in terms of how far they go and how much time elapses in transit. A penalty is imposed if the bicycle is stolen or damaged. By enabling constant monitoring, such technologies have improved contract enforcement and can potentially increase the provision of public goods. This concept is being expanded to include car rentals in central London and is leading to the creation of the 'sharing economy'. The ramifications of this are profound as technology may have the ability to solve key issues related to trust, monitoring and the provision of goods. This in turn can improve economic, health and environmental outcomes.

3. India's App Ecosystem Challenges

The Indian app ecosystem is characterised by weak network infrastructure; the dominance of the Android OS; a trifurcation of low-, middle-range and high-end devices; an ambivalent policy environment and a high degree of socio-economic heterogeneity. The high growth rate of the adoption of smartphones in India coupled with its service deficit suggests that the Indian economy has a high score on the App Gap Index (i.e. India has the potential to excel in the production and consumption of apps that address core developmental issues).[36] However, the Indian app economy is not free from significant ecosystem bottlenecks.

Although the Indian mobile space is largely dominated by voice,[37] the advance of high-end feature phones, smartphones and low cost tablets represents an indisputable shift towards greater data consumption (the number of 3G SIMS is expected to grow from 35 million in 2012 to roughly 272 million by 2017[38]). Currently India's smartphone penetration stands at 10 percent but is likely to rapidly increase since India is the world's fastest growing cellular network.[39] Illustratively, between 2012 and 2013, the number of smartphones in urban India increased by 89 percent to reach 51 million.[40] 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 will see a reverse trend).[41]

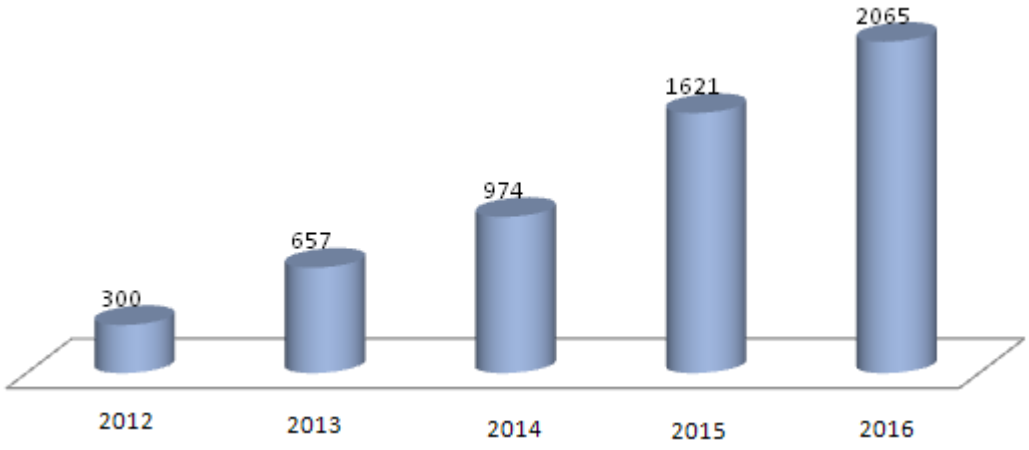
The increase in smartphone consumption bodes well for the Indian app economy as the average smartphone in India hosts 17 apps.[42] Furthermore, since much of the increase in smartphone consumption is driven by consumers aged 16-18,[43] app usage is likely to grow (Pew Research conducted in the United States shows that the youth are heavy consumers of data).[44] India's app

[36] "The App Gap Index." The *Economist Intelligence Unit*. (2013).
[37] Kathuria, Rajat. "The Next Stage of Telecom Growth." *International Management Institute Magazine*. (2011): 2-6. Web.
[38] Analysys Mason cited at: "3G users in India to touch 272 million by 2017 from 35 million in 2012: Analysys Mason." *TelecomLead*. N.p., 21 June 2013. Web. 20 Jan. 2014. <http://www.telecomlead.com/3g/3g-users-in-india-to-touch-272-million-by-2017-from-35-million-in-2012-analysys-mason-38292/>.
[39] Adler, Richard, and Mahesh Uppal. M-Powering India. Gurgaon: Aspen Institute India, 2008. Print.
[40] 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>.
[41] International Data Corporation projections
[42] Data from: "Questions about the mobile consumer?."*Our Mobile Planet*. Google. Web. 19 Jan. 2014. <http://www.thinkwithgoogle.com/mobileplanet/en/>.
[43] Nerurkar, Sonal . "Teens drive Indian smartphone sales, study finds." The Times of India. 8 Sept. 2013. Web. 20 Jan. 2014.

[44] Smith, Aaron. "Smartphone Ownership — 2013 Update ." *Pew Research Center* (2013): *http://pewinternet.org/*. Web. 20 Jan. 2014.

economy is gaining international traction as the country is among the top five download regions for the Amazon app store [45] and is a key focus of Nokia's expansion strategy into the app space.[46] These developments point towards a positive trend (see figure 8) and at this juncture, it is important to facilitate the development of the Indian app economy by critically examining its weaknesses and identifying the factors that may plateau its growth trajectory so that they can be addressed in a timely fashion. The next two subsections focus on India's physical, financial and innovation infrastructure.

Figure 8: Projected Revenue from Paid Apps in India (rupees crore)



Source: Avendus Analysis

3.1 Challenges with Supporting Physical Infrastructure

Given that the app economy is heavily driven by data and is also a key driver thereof, its growth and success depend on the availability of quality of infrastructure as well as policies that enable greater data transfer and consumption. If good network coverage and capability are lacking, as is the case in India where mobile broadband penetration is hardly five percent of the population,[47] app developers are forced to compromise on the richness of content and have to devote larger parts of their time to performance optimisation.[48] On the user-end, slow download speeds and unpredictable connectivity can dampen user experience and disrupt mobile payments, thereby constraining the app economy's potential demand base.

[45] "India among top five download regions for Amazon app store: Parag Gupta."*Business Standard* [New Delhi] 25 Nov. 2013: Print.
[46] Gupta, Deepali . "Microsoft turns to Bollywood to spruce up Apps store." *The Economic Times* [Delhi] 12 Dec. 2013: n. pag. *The Economic Times*. Web. 11 Feb. 2014.
[47] International Telecommunications Union 2012
[48] ICRIER Consultations.

While there has been significant telecom infrastructure development in India (since 2007 the tower industry has more than quadrupled in size and the optical fibre network has doubled in terms of coverage),[49] telecom infrastructure growth has insufficiently kept pace with India's rising data demand.[50] Compared to regional counterparts such as Sri Lanka, India has been laggard in terms of the adopting the latest telecommunications technology (Sri Lanka commercially launched 3G four years before India in 2006).[51] In the 2011-12 global competitiveness report, the World Economic Forum (WEF) ranked India 89th out of 142 countries for its infrastructure[52] stating that the country's transport, ICT and energy infrastructure is 'largely insufficient and ill-adapted to the needs of business.'[53] More specifically, in its Network Readiness Index 2013, the WEF ranked India 68th out of 144 countries.[54]

Increasing 3G deployment is imperative to facilitate the growth of the app economy. Due to high spectrum prices and institutional weaknesses, operators have limited 3G deployment to metros and tier 1 cities.[55] Illustratively, in 2012, there were only 35 million 3G connections with more than half of all 3G-enabled smartphone owners still accessing data through 2G.[56] Moreover, 'data services represent less than ten percent of service provider revenue today,'[57] indicating that there is enormous potential for improvement. Since India's operators are among the most heavily taxed in the world and face fast decreasing average revenue per user (ARPU),[58] **TRAI and DoT must ease operator margins to encourage the expansion of 3G to tier 2 and 3 cities and subsequently rural areas.** The possibility of leapfrogging into newer generations technologies such as 4G must also be considered.

While voice is still dominant in the Indian market,[59] studies reveal that there was a 92 percent increase in mobile data traffic generated by both 2G and 3G in the fiscal year 2012.[60] 'Mobile operators are struggling to handle the growing data traffic. They are adding as much capacity as

[49] 6th Annual Conference on Telecom Infrastructure in India – Changing Scenario: New Challenges and Opportunities, New Delhi (2012)
[50] Narayana Murthy interview in "The opportunity and challenge of India's infrastructure." *gridlines*. PwC,. (2013): Web. 20 Jan. 2014.
[51] Galpaya, Helani, 2011. Broadband in Sri Lanka: Glass Half Full or Half Empty?. Washington, D.C: infoDev /World Bank.
[52] Schwab, Klaus, Sala-i-Martin Xavier , et al. "The Global Competitiveness Report 2011–2012." *World Economic Forum*. (2011). Web. 20 Jan. 2014. <http://www3.weforum.org/docs/WEF_GCR_Report_2011-12.pdf>.
[53] Ibid.
[54] Bilbao-Osorio, Beñat , Soumitra Dutta, et al, et al. "The Global Information Technology Report 2013 Growth and Jobs in a Hyperconnected World." World Economic Forum & INSEAD. (2013): Web. 20 Jan. 2014.
[55] Analysys Mason cited at:"3G users in India to touch 272 million by 2017 from 35 million in 2012: Analysys Mason." *TelecomLead*. N.p., 21 June 2013. Web. 20 Jan. 2014.
[56] "MBit Index India Study." *Nokia Siemens Networks* (2013): Web.
[57] Ibid.
[58] Adler, Richard, and Mahesh Uppal. M-Powering India. Gurgaon: Aspen Institute India, 2008. Print.
[59] Kathuria, Rajat. "The Next Stage of Telecom Growth." *International Management Institute Magazine*. (2011): 2-6.
[60] "MBit Index India Study." *Nokia Siemens Networks* (2013): Web.

they can to their networks within investment and spectrum constraints. They are also off-loading traffic to Wi-Fi wherever possible.'[61] This situation is exacerbated by the fact that the emergence of cloud-based apps will result in a further surge in data traffic. To ensure that the growth of the app economy does not plateau due to spectrum constraints, **it is recommended that the supply of contiguous spectrum available for mobile is increased by re-farming from non-commercial players such as defence[62] and by converting analog television broadcasting to digital** (as the latter is more spectrum-efficient).[63] **It is also important that telecom operators engage in more infrastructure sharing and that 'non-discriminatory access to essential backbone, at cost oriented prices, is provided.' Finally, it is imperative to outline a clear exit policy for inefficient, incumbent telecom operators and have an optimum mergers and acquisition policy in the telecom sector.**

To expand rural connectivity, the currently underway National Optical Fibre Network scheme (which aims to provide broadband connectivity to over 238,000 gram panchayats) is timely. However, India must also adopt new technologies to address last mile connectivity problems (as without this, the penetration of apps will be limited to urban areas). Work by Quadri et al (2011) shows the wireless mesh networks can increase connectivity in rural areas.[64] A pilot mesh project was launched in Gazipur, Bangladesh where satellite link or the last coverage point of GSM/CDMA-based network was used to connect the local mesh to the global network. They found that the ownership can be shared to bring down the cost of such network deployment and that 'next generation communication technologies can be tailored to meet local needs.'[65] **India should be at the forefront of testing and adopting new technologies that can better facilitate affordable broadband services in rural areas such as wireless mesh networks.**

While India's infrastructure growth rate has been relatively high, at an estimated 7.9 percent in the fiscal year 2013,[66] foreign direct investment (FDI) in infrastructure has not kept pace due to recent policy flip flops and associated scams (such as the 2G license episode where 122 licenses

[61] "Maximizing Mobile." World Bank (2012): Web. 20 Jan. 2014.
[62] Kathuria, Rajat; Kedia-Jaju, Mansi. India: The Impact of Internet**.** IAMAI, Department of Information Technology, Government of India and ICRIER, 2011.
[63] "ICT for Greater Development Impact: World Bank Group Strategy for Information and Communication Technology ." *World Bank*. (2012): Web.
[64] Quadri, A , Hasan Mehedi , et al. "Next generation communication technologies: Wireless mesh network for rural connectivity." GLOBECOM Workshops, IEEE. (2011). Web.
[65] Quadri, A , Hasan Mehedi , et al. "Next generation communication technologies: Wireless mesh network for rural connectivity." GLOBECOM Workshops, IEEE. (2011). Web.
[66] Business Monitor International, 2013.

were recalled). These incidents have dampened sentiments and resulted in a decline in investment which has been injurious the sector's growth. **It is essential that India has spectrum rules that are open, transparent, predictable and available in the public domain.**[67] The Supreme Court also reasoned that to allocate natural resources, more than one method can be used and that the auction is not a constitutional mandate.[68]

Finally, India's power grid needs to keep pace with telecom infrastructure development. 'India is in a situation where telecom penetration has exceeded grid power penetration/availability such that it is increasingly tough to sustain the spiralling energy costs [for telecom infrastructure suppliers].'[69] On the demand-side, mobile phone users in remote off-grid localities, struggle to charge their phones. For example, '40 residents of the village of Kajrai (population 700) in the state of Madhya Pradesh have acquired mobile phones. Although the village has wireless service, it does not have electricity. As a result, the residents of the village must travel almost 20 kilometres every day to get their phones charged.'[70] **A short-term measure is for the Government to promote the usage of mobile phones that have solar charging capacity/are pedal-operated or battery charged (where batteries are obtained on a rotational basis from a nearby town). However, in the long-run, India will have to undoubtedly increase its electricity grid capacity to help both telecom infrastructure suppliers and mobile phone users.** This illustrates that a mobile broadband ecosystem needs to exist for effective and efficient app uptake.

3.2 Challenges with Supporting Financial and Innovation Incubation Infrastructure

The app economy is knowledge-intensive and driven by innovation and entrepreneurship. Building the software base of an app is relatively simple due to the widespread availability of open-source software-building tools. However, the procurement and assimilation of content for certain apps may prove to be expensive or time-consuming, especially if the app is targeted towards enhancing developmental outcomes. Evidence collected by the World Bank shows that 'using mobile applications for development typically requires an ecosystem of content providers (e.g. doctors for a healthcare app) or agents (e.g. banks for a commerce app).'[71] The success of

[67] Adler, Richard, and Mahesh Uppal. M-Powering India. Gurgaon: Aspen Institute India, 2008. Print.
[68] "Auction not sole route for allocation of natural resources: Supreme Court." *The Hindu* [Delhi] 27 Sept. 2013: Web. 10 Feb. 2014.
[69] Singh, Prashant Veer. "Changing the Landscape of Telecom Infrastructure (Whitepaper)." *Bharti Infratel Limited*. (2011): . Web. 20 Jan. 2014.
[70] Adler, Richard, and Mahesh Uppal. M-Powering India. Gurgaon: Aspen Institute India, 2008. Print.
[71] "Maximizing Mobile." World Bank (2012): Web. 20 Jan. 2014.

such ‘ecosystem-based apps’ is predicated upon the existence of a conducive ecosystem that provides long-term capital; entrepreneurship support in terms of technical assistance and government partnerships; and innovation incubation through technology clusters and schemes that promote dynamic learning effects.

While India is known for its entrepreneurial drive and is an established IT-services powerhouse, less than satisfactory rankings on indicators such as the number of days needed to start a business (27 in India), corruption perceptions (36th), the ease of doing business index (132) and venture capital availability (3.4 out of 7) demonstrate that India can create a more enabling environment for business and innovation (see figure 9). An unfavourable business environment can result in many Indian software developers migrating abroad (e.g. to Silicon Valley) or focusing their energies on catering to foreign app demand rather than producing locally-relevant content.

Figure 9: Business Environment & Entrepreneurship

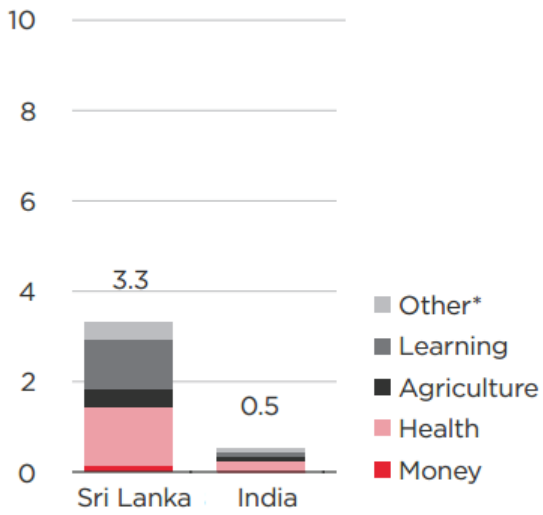
2011	Sri Lanka	India	Bangladesh	United Kingdom
Venture capital availability (1=very difficult; 7= very easy)*	2.8	3.4	2.3	3.4
Impact of ICT on new products, services & business models (1=not at all; 7= significantly)*	4.8	5.0	4.0	5.9
Impact of ICT on access to basic services (1 = do not enable access at all; 7 = enable access)*	4.7	4.4	3.9	5.4
Corruption Perception Index 2012 (0 = highly corrupt, 100 = highly clean)	40	36	26	74
Ease of doing business rank**	96	132	129	7
Business entry density rate	0.58	0.09	0.10	10.41
Number of days to start a business	7	27	19	13

Source: Global ICT report 2011, World Economic Forum (2011*, 2012**)

Research shows that governments are best placed to ‘establish an enabling environment that strengthens the entire innovation value chain: ideation, research and development, funding, and

commercialization'[72] The government may be uniquely equipped to jumpstart the app economy through ecosystem-enhancing measures, advocacy and awareness campaigns,[73] and public private partnerships, especially in the area of e-governance apps (although, it should be cautious as to limit its role to that of a market enabler). **The Government of India can invest and foster innovation in apps that have public good characteristics.** The Global Information Technology report 2013 shows that governments can play a more proactive role in promoting ICT innovation. For example, India ranks 45 out of 144 countries for the importance of ICT to government vision while Sri Lanka ranks 14.[74] Similarly, India ranks 83 for government procurement of advanced technology whereas Sri Lanka ranks 7.[75] Some of these rankings may help explain why Sri Lanka provides more M4D services in health, agriculture and education per million subscribers than India (as shown in figure 10), although factors related to size and income per capita are also at work.

Figure 10: M4D per million unique mobile subscribers



Source: GSMA Intelligence Country Overview: Sri Lanka
Data: MDI Products and Services tracker, MDI Analysis

[72] "ICT for Greater Development Impact: World Bank Group Strategy for Information and Communication Technology ." *World Bank*. (2012): Web. 20 Jan. 2014.
[73] Kathuria, Rajat. "The Next Stage of Telecom Growth." *International Management Institute Magazine*. (2011): 2-6.
[74] Bilbao-Osorio, Beñat , Soumitra Dutta, et al, et al. "The Global Information Technology Report 2013 Growth and Jobs in a Hyperconnected World." *World Economic Forum & INSEAD*. (2013). Web. 20 Jan. 2014. <http://www3.weforum.org/docs/WEF_GITR_Report_2013.pdf>.
[75] Bilbao-Osorio, Beñat , Soumitra Dutta, et al, et al. "The Global Information Technology Report 2013 Growth and Jobs in a Hyperconnected World." *World Economic Forum & INSEAD*. (2013). Web. 20 Jan. 2014. <http://www3.weforum.org/docs/WEF_GITR_Report_2013.pdf>.

While the potential for M4D/ecosystem-based apps has been recognized by the Government of India, there is little activity or support on the ground-level as per the view of several app developers.[76] Stakeholder consultations reveal that innovators seeking to develop M4D apps currently struggle to get the necessary capital or technical support.[77] This may be because Indian investors, who are anecdotally known to be risk-averse, prefer not to support apps that may be potentially path-breaking but carry high risk (most M4D apps require long-term investment and have significant gestation periods due to testing requirements and slow returns). [78] **In the absence of market funding, the government could step in to create and develop the M4D app market till it is sufficiently mature to operate without support.** A good example of a current policy initiative is the India Inclusive Innovation Fund established by the National Innovation Council. Such measures must increase in number and **social security nets must also be provided to minimise the personal risk of undertaking entrepreneurial activity.**

Regarding innovation incubation, India needs to put in place an 'innovation policy that explicitly supports networking among industry, universities, and public researchers'[79] so that group synergies are exploited to create apps that serve multiple societal interests (currently 80 percent of apps in India fall under the infotainment and social networking category).[80] **The government should exploit technological complementarities and use a cluster approach, which encourages collaboration between different stakeholders, to disseminate the use of apps for e-governance, healthcare, education etc.**[81] Examples of effective state support already exist in India (see box 1) such as *Startup Village* in Kerala (as well as in other countries such as Chile, whose experiences may inform India). These measures may help in bolstering the growth of the app economy.

[76]ICRIER Consultations
[77]Ibid.
[78] ICRIER Consultations.
79 "ICT for Greater Development Impact: World Bank Group Strategy for Information and Communication Technology ." *World Bank*. (2012): Web.
80 ICRIER Consultations
81 "ICT for Greater Development Impact: World Bank Group Strategy for Information and Communication Technology ." *World Bank*. (2012): Web.

Box 1: Start Up Chile and Start-Up Village in India

Start-Up Chile is a program created by the Chilean Government that "*seeks to attract early stage, high-potential entrepreneurs to bootstrap their start-ups in Chile."* The program assigns selected projects a USD 40,000 grant each along with a one-year resident visa for team members who are assigned a shared workspace in Chile with entrepreneurs from 60+ countries. The program also advertises the benefits of the "*networking, inspiration, and productive experience that comes with joining a community of 750+ start-ups,"* which in other words constitutes agglomeration benefits. Indian start-ups accounted for 9 percent amongst the list of start-ups selected in 2013. These included app development start-ups such as *TeliportMe*, *Zestbuds* and *Etyacol*.

Start-Up Village is India's first business incubator in public-private partnership. Its promoters include the Department of Science and Technology, Government of India, Technopark, Trivandrum and MobME Wireless. Start-up Village provides members with workspace, high-speed Internet, legal and intellectual property services and access to high-profile investors. Other incentives include tax breaks for recognised incubate companies, the possibility of funding from the Start-up Village Angel Fund and a host of advisory services (including legal, technical and promotional assistance). Recently Start-Up village also started the Dev1000P programme – a free training programme for young developers to receive training in app development and design for the Android platform. This initiative complements existing government schemes. The State Government of Kerala allows up to 20 percent attendance and 4 percent grace marks for student entrepreneurs who engage in innovative work.

Source: Official Sites of Start Up Chile and Start Up Village

Policy measures are being undertaken by the Government of India to improve the entrepreneurship and innovation ecosystem. In the area of innovation incubation, India's recent Science, Technology and Innovation policy (2013) states that 'risk sharing by the government will significantly increase private sector investment in R&D'[82] and that a 'regulatory and legal framework for the sharing of IPRs between inventors and investors will be put in place'[83] to further encourage the private sector to innovate. The government will also play a more proactive role in driving demand by putting in place 'a public procurement policy that favours first-of-its-kind products developed through indigenous innovation.'[84] This could aid in the development of, among other products, path-breaking M4D apps. The policy further states that it will promote such products globally.'[85] The policy aims at creating an overall conducive ecosystem by 'promoting mechanisms such as Small Idea-Small Money and Risky Idea Fund to support

[82] Government of India. Ministry of Science and Technology. *Science Technology and Innovation Policy 2013*. New Delhi: 2013. Web.
[83] Ibid.
[84] Ibid.
[85] Government of India. Ministry of Science and Technology. *Science Technology and Innovation Policy 2013*. New Delhi: 2013. Web.

innovation incubators'[86] and aims to '[invest] in young innovators and entrepreneurs through education, training and mentoring.'[87] These measures, if implemented in letter and spirit, will benefit the app economy.

Since the Indian app economy is experiencing signs of growing success (as box 2 shows), this is the opportune moment for the government to step in and address ecosystem bottlenecks that may prevent it from reaching a level of global competitiveness. However, it is important to remember that **the government's role must be limited to that of an 'enabler'** or 'catalyst' and that it should not micro-manage or extensively 'pick winners' such that competition and innovation are stifled.

Box 2: Signs of Success and Global Interest in the Indian App Economy

Facebook Inc.'s recent purchase of Bangalore-based *Little Eye Labs* (which provides analysis and monitoring services for improving mobile apps) should increase the confidence with which investors view mobile app developers in India. *Little Eye Labs* was backed by seed investments from Venture East Fund and GSF Superangels and Facebook's purchase is one of the few examples of a successful exit following investment in an app development start-up in India.

Increasing instances of success experienced by Indian app developers and the Indian mobile app development space appear to be attracting favourable attention from Venture Capital funds. In May 2011, the Indian app development firm *Sourcebits* received US $10 Million in investment from venture capital firms Sequoia Capital and IDG Ventures following its success on the Apple iOS App Store. Other notable investments have included Kae Capital's investment in cloud-based app back-end developer *ShepHertz Technologies* and Kalaari Capital's investment in *Robosoft Technologies Pvt. Ltd.*

Source: "Facebook buys Little Eye Labs in first India acquisition." Live Mint & The Wall Street Journal [Delhi] 8 Jan. 2014. LiveMint. Web. 2 Feb. 2014

Unlike M4D apps, which due to their public good characteristics require government intervention, apps which cater to commercial and organizational needs (i.e. enterprise apps) have recently seen interest from foreign and domestic investors Microsoft attests that the rich

[86] Ibid.
[87] Ibid.

developer ecosystem in India makes it the ideal place for developing commercial applications [88] and has consequently, launched a scheme to facilitate the development of enterprise apps by Indian start-ups (see box 3). This indicates that the market has recognized the potential for enterprise apps and is beginning to capitalize on this opportunity in India.

Box 3: Code for Honour: An Example of Innovation Incubation for Enterprise Apps

In December 2013, Microsoft launched a contest titled 'Code for Honour' – a contest to create over 100 apps for businesses and governments over the course of six months. The contest is open to over 5000 independent software vendors and tech startups in India to develop apps and solutions in four categories. These are, 1) enterprise apps and solutions 2) micro, small and medium enterprise apps and solutions, 3) government enablement and 4) citizen services. The revenue sharing model gives 75 percent of the revenue to developer if total revenue is below 25,000 USD and 80 percent if it is over (the remaining goes to Microsoft). Microsoft India's chairman Bhaskar Pramanik said, "With the proliferation of devices and cloud-based services, governments, businesses and other organizations are seeking to interact with customers, partners and other stakeholders securely and reliably. Code for Honour will kick-start the creation of apps and solutions that are scalable, reliable and secure and that can be used over public, private and hybrid clouds." The contest is supported by the National Informatics Centre, NASSCOM, TiE, Nokia, Intel and BarrierBreak.

Source: "Microsoft launches 'Code for Honour' content for new app development." [Delhi] 19 Dec. 2013MSN News. Web. 3 Feb. 2014

[88] "Microsoft launches 'Code for Honour' content for new app development." [Delhi] 19 Dec. 2013: MSN News. Web. 3 Feb. 2014

4. App Developer and Distributor Side Challenges

4.1 Lack of Localised Content

Indian app developers are not creating much localised content as there is a paucity of domestic app stores/distribution channels that offer internationally competitive revenue shares from where app developers can promote India-specific content which users can easily discover. [89] For the few local app stores that do exist, revenue sharing does not favour app developers (this is particularly true of some telecom operator-managed app stores such as Reliance's RWorld, Aircel's App Store and Idea's mobstore which attracted attention in 2010 but subsequently phased-out as revenue sharing was decided on an ad-hoc basis and often resulted in app developers getting as little as 30 percent of the total share). Skewed revenue sharing models have led Indian app developers to focus on international app stores such as Apple's App Store or Google's PlayStore which offer a flat 70 percent of the total revenue to developers. Highly India-specific apps would, in all likelihood, get side-lined in such international stores. Therefore, Indian developers have focussed on creating more international content. For example, popular apps designed by Indians such as Saavn and Zomato are, to a large extent 'borderless.' The former has expanded its musical lexicon to include both Indian sub-continental and Western music, and the latter is growing geographically to document restaurants not only in India, but also in Turkey, the United Kingdom, Brazil etc.

There are signs that the Indian market is realising the need to ensure domestic scale and is devising innovative distribution channels for uniquely Indian apps. A case in point is AppsDaily which is a physical chain of retail stores for apps located in over 140 Indian cities. An app user can visit an AppsDaily outlet and purchase an app much like s/he would purchase any other good (see box 4). Having an offline app store with a physical attendant is necessary in the Indian context where mobile payments have not taken off and where awareness is still limited such that assistance and information sharing are often required. Such **business model innovation in**

[89] India-specific content does not preclude international content that is highly relevant to the Indian context and demanded by Indian app users.

distribution channels will help unlock the latent domestic demand for locally relevant content.

Box 4: India's Offline App Store

Conceived in India, AppsDaily aspires to be the world's largest offline app distribution channel. Having its origins in a country where digital literacy and awareness are low and network infrastructure is weak, the AppsDaily team felt it necessary to establish a chain of physical retail outlets from where mobile users could buy apps over the counter (much like any other good or service). Its physical presence circumvents issues related to m-payment regulation in India and offers real time guidance to customers who are new to the world of apps. AppsDaily also addresses discoverability issues by filtering out apps such that only the most relevant and useful content, as determined by the local context, is offered to customers. AppsDaily 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. 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.

Source: www.onwardmobility.com

Furthermore, Vodafone has recently released its beta app store with an internationally competitive 70-30 revenue sharing model. If other Indian telecom operators similarly create app stores with competitive revenue sharing models and market them well so that their reach is expanded, it is likely that Indian app developers will be ready to tap into the domestic market and create localised content. There are signs that Vodafone's beta app store is successful undertaking. [90] **Indian app developers need more competitive app stores/distribution channels which cater to the domestic market, where localised content is easily discoverable such that its creation is viable from a business point of view.**

Additionally, OEMs may want to collaborate with app developers to devise mechanisms to allow more devices to host Indic scripts so that they can tap into the potentially large market for regional language content. This would require both technical and marketing solutions. India has 22 official languages and 11 scripts besides English. Therefore, to attain national scale, it becomes imperative that devices can support different scripts and that developers make apps in different languages.

[90] ICRIER Consultations

Box 5: India Lags Behind China in terms of Localised Content

India's experience on the whole is in contrast to China, where local app stores and distribution channels (inclusive of social networking sites) have gained popularity and have allowed developers to tap into the large domestic market. China's local app store success can be largely attributed to language constraints and censorship regulation which have promoted the growth of indigenous, localised content. In the absence of such conditions, the Indian app economy will need to be more innovative when it comes to promoting the same.

4.2 Fragmentation

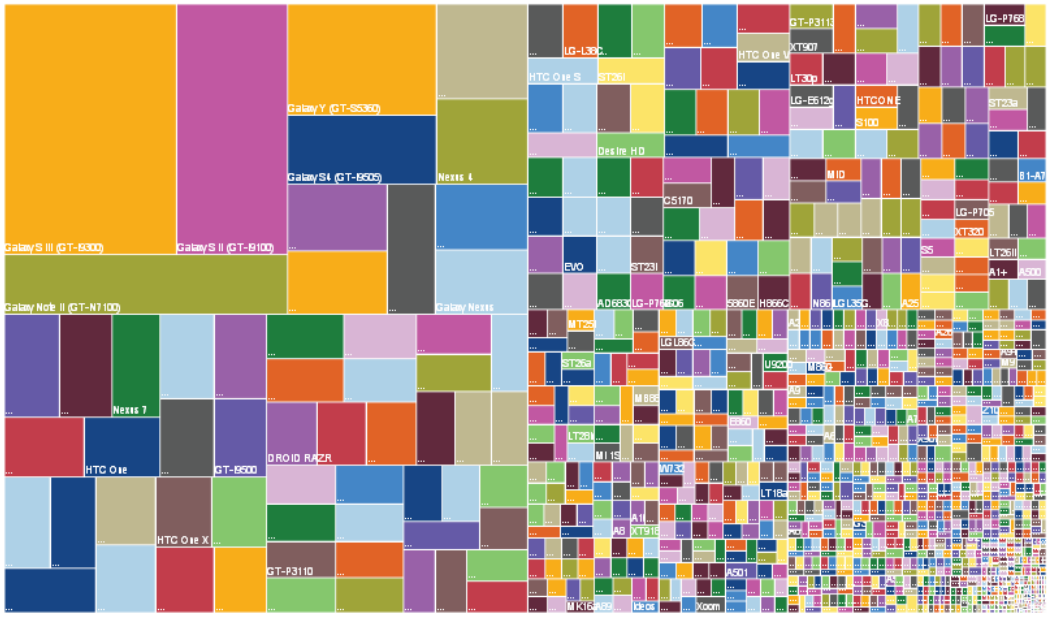
The Indian mobile phone market is dominated by the Android OS since Android devices are more affordable. The Android ecosystem is open in that different OEMs such as Samsung and HTC produce mobile devices that use the Android OS. The result is that the Android ecosystem has become highly fragmented with a plethora of devices with different screen sizes, resolution limits and hardware traits (see figures 11 and 12). Because of this, "developing apps that work across the whole range of Android devices can be extremely challenging and time-consuming."[91] To complicate matters for app developers, an additional level of fragmentation occurs on the API level for Android. While 95 percent of Apple users worldwide have migrated to the newest version of the operating system (which was iOS 6 at the time this data was collected), less than 1 percent of Android users have moved to the latest Android OS.[92] According to an Indian technology evangelist, the churn of mobiles is not high in India because users tend not to have the disposable income to replace their old mobile device with the latest version.[93] The issue of interoperability is not as pronounced in developed countries where the churn of the mobile phone is higher. As such, **Indian app developers have to be particularly cautions in ensuring that their app has 'backward compatibility' i.e. that it can work across old devices as well as new ones, and also function across both old and new versions of operating systems.**

However there are signs that this issue is being gradually addressed by the sector. Blackberry 10 has a run-time feature which makes Android apps compatible with Blackberry ones. Blackberry envisions a future where Android apps can be directly used on Blackberry devices without needing any changes. Additionally, with the emergence of HTML 5, it is likely that more apps will be HTML-based so that they can run on any mobile device and OS platform. However, in

[91] "Android Fragmentation Visualized (July 2013)." *Android Fragmentation Report July 2013*. Web. 20 Jan. 2014.
[92] Ibid.
[93] ICRIER Consultations

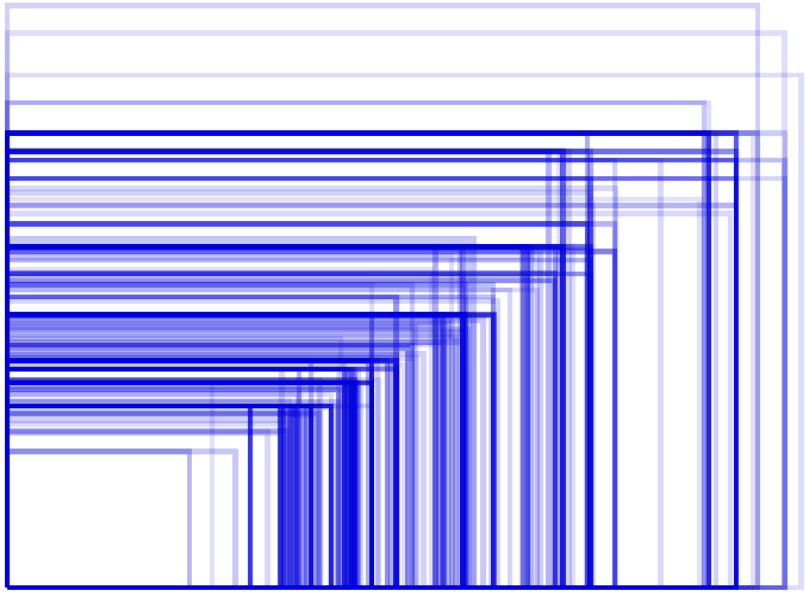
the short-term, Indian app developers will still need to focus on backward compatibility more than their Western counterparts.

Figure 11: Global Device Diversity on the Android OS



Source: Open Signal, July 2013.
The size of each box corresponds to the prevalence of that device on the Android OS.

Figure 12: Screen sizes for Android across the World



Source: Open Signal, July 2013.
This graphic shows the various physical screen sizes on Android phones, with the darkness of the lines representing their frequency

4.3 Design

User interface and interactive design have been cited as areas that need more attention by app developers in India. Stakeholders have attributed the problem not to lack of skill but to a lack of attention. They believe that if more effort is devoted to design, to both the friendliness of the user interface and visual aesthetics, then Indian apps can perform significantly better. According to an app analytics company, *Apigee*, apps developers must 'wed the complexities of real-world enterprise with the single-purpose nature of apps using design techniques like progressive disclosure.'[94] (Progressive disclosure involves maintaining the user's attention by minimizing cognitive workload and presenting only the minimum data required for the task at hand). Similarly, in the experience of *Make My Trip*, it was difficult to access personnel who specialized in interactive design and techniques such as progressive disclosure. 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 a decision was reached). **It is recommended that app developer teams in India have employees who come from a mix of backgrounds that span from software engineers to design professionals and psychologists such that an in-depth understanding of visual aesthetics and user behaviour is gained.**

4.4 Mobile Payments

In the global economy, the monetization of apps has been problematic due to the high prevalence of free apps. However, alternative monetization methods such as the freemium model and in-app purchases have gained traction as they have successfully price-discriminated against users with relatively inelastic demand. For example, in a popular app, *Temple Run*, the purchase of coins has become common amongst dedicated gamers as these coins help unlock extra features.

In India the problem of monetization of apps is further exacerbated by the low penetration of credit and debit cards, the high failure rate of online payments due to low network capabilities and the mobile-payments regulation. **The long-term policy measure to tackle this issue is to increase India's financial penetration which will ensure that a large proportion of users *can***

[94] Mulloy, Brian , and Kevin Swiber . "Ten Steps to Bring the App Economy to Enterprise IT." Apigee, 14 Nov. 2013. Web. 13 Feb. 2014.

engage in e-transactions and to increase broadband penetration which will ensure that more users are *willing* to make such transactions by reducing their failure rate (distrust of e-payments is a frequently cited issue in India).[95]

The short-term policy measure that can help app developers monetize is to alter the current mobile-payments regulation in a manner that eases payments but does not compromise on security. Often, due to the requirement of the One Time Password (OTP), delivered by SMS, users have to exit the app, view their OTP and re-enter to complete a transaction.[96] The process of exiting an app and re-entering increases the failure rate of transactions and makes the process less user friendly.

In other app markets such as the United Kingdom's, one touch payments are common. Users simply have to feed in their credit /debit card details into their app store once. Thereafter, these details are stored for all future transactions. This allows users to subsequently only click 'buy' to purchase the app without needing to enter any card details again. This 'one touch payment method' significantly reduces the hassles of app purchases and makes the process fast and easy.

In the Indian context, app distribution channels and app stores may want to establish tie-ups with telecom operators to facilitate the billing of app purchases. Since the majority of India's mobile market is prepaid, telecom operators are uniquely placed to facilitate small payments associated with apps, provided they engage in fair and competitive revenue sharing with developers.

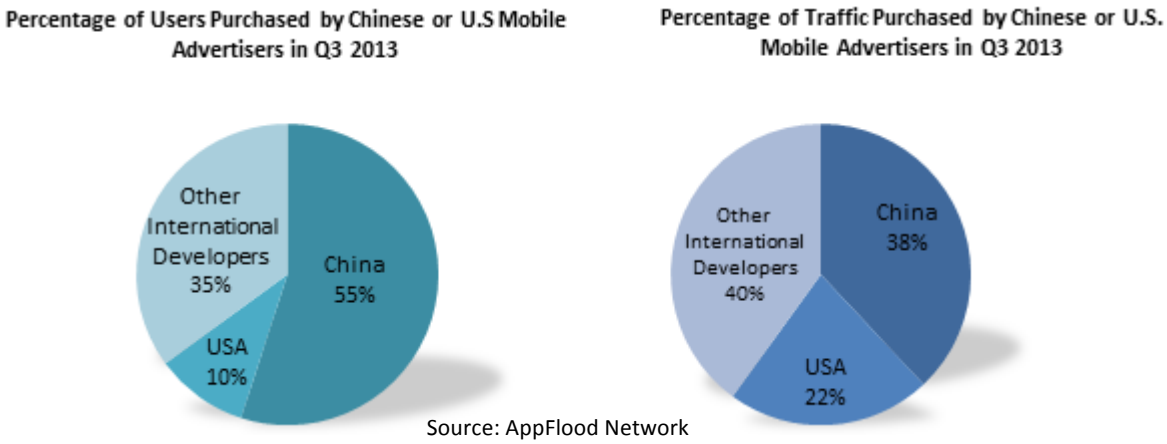
4.5 Marketing, Publicity and Awareness

Indian app developers need to promote the 'Made in India' tag more aggressively. As *Appflood* analysis shows,[97] China and the USA purchase majority of the traffic and users on the *AppFlood* marketing network to advertise their apps (figure 13). Indian app developers should engage in innovative marketing measures such as 'partnering with community radio stations to host a Q&A sessions about the app.'[98] **It is important that app developing companies build strategic partnerships with media outlets that might benefit from their product/data**.[99] This is critical

95 ICRIER Consultations
96 Ibid.
97 AppFlood Network 2013
98 "Mobile Usage at the Base of the Pyramid in Kenya." *infoDev* (2012): Web. 20 Jan. 2014.
99 Ibid.

because ‘users largely get their information through word of mouth, TV, radio, and newspaper. Lower awareness translates to lower usage. Therefore, investment of time and resources into marketing is essential.

Figure 13: Expenditure on App Advertising



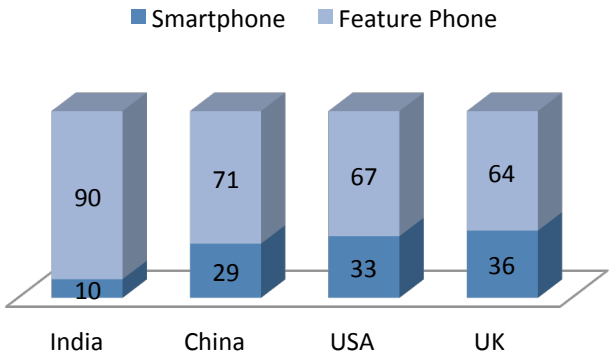
Source: AppFlood Network

5. Demand Side Challenges

Finally, on the consumer side, the potential demand base for the app economy is constrained due to lack of awareness and low literacy rates, among other reasons. This is a problem for many developing countries. However, the challenge in India is more complex due to its size and linguistic heterogeneity. The demographic of users is as follows: 10 percent of young mobile phone users in India own a smartphone (figure 14). Out of these, 80 percent are male (figure 15). The penetration of advanced data users among the Indian youth is only 13 percent (figure 16). India is also a highly price sensitive market as 40 percent of the people say that price drives their mobile phone purchases (figure 17).

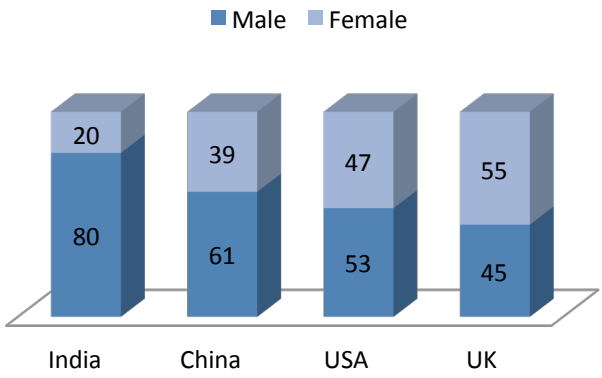
These preliminary consumer statistics indicate that India must strive to achieve gender parity in mobile phone usage, ensure that the benefits of data are known to mobile device users and keep in mind that overly expensive apps, data plans or devices are unlikely to take-off in the rural or semi-urban Indian market.

Figure 14: Smartphone versus Feature Phone Penetration (Age 15-24)



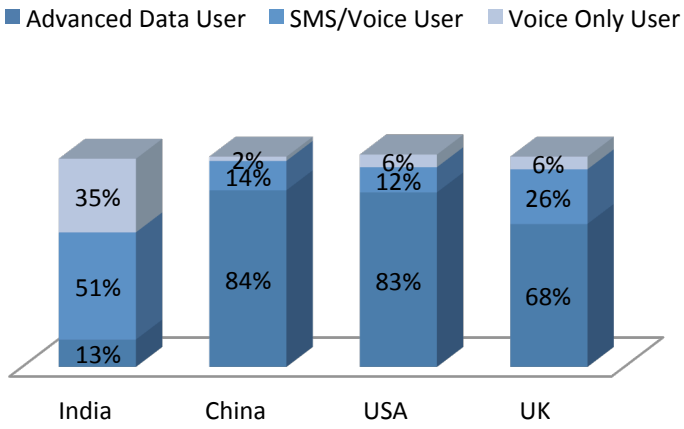
Source: Mobile Youth Around the World, Nielson (2010)

Figure 15: Penetration of Advanced Data User (Age 15-24)



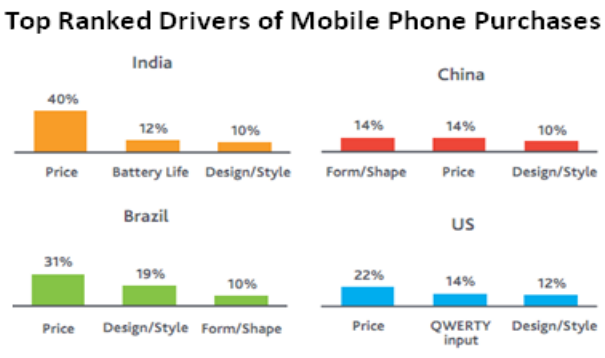
Source: Mobile Youth Around the World, Nielson (2010)

Figure 16: Penetration of Advanced Data Users (Age 15-24)



Source: Mobile Youth Around the World, Nielson (2010)

Figure 17

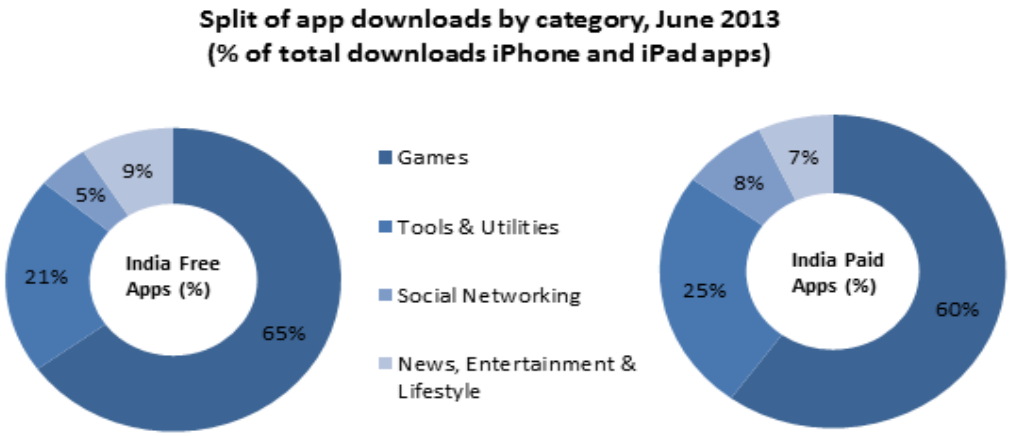


Source: Mobile Youth Aound the World, Neilson (2010)

5.1 Awareness

Currently, apps in India, much like apps around the rest of the world, are being primarily used for gaming and entertainment (figure 18). Awareness needs to be built up regarding the full utility of mobile apps and how they can be used not only for social purposes but also to address business and developmental needs. Owners at the BoP should be made aware of the difference between phone-based features, applications and the Internet since the confusion around such terms is hypothesized to be an additional reason for low uptake.[100] **OEMs can help bolster awareness by pre-installing relevant apps and telecom operators are well-placed to engage in mass awareness schemes as a large proportion of the benefits of increased data consumption will accrue to them.** The aforementioned players are well-placed to supplement existing government initiatives. Strong efforts should be made to ensure that ICT technologies also reach marginalised groups such as women and historically-discriminated castes. This reaffirms the need for greater education, digital literacy and awareness promotion schemes.

Figure 18: Types of Apps Used



Source: XYO Logic

[100] Based on conclusion of "Mobile Usage at the Base of the Pyramid in Kenya." *infoDev* (2012): Web. 20 Jan. 2014.

5.2 Language and Illiteracy

India's literacy rate is 62 percent. Many stakeholders believe that illiteracy is constraining the user base of apps. For example, there was an initiative to use the Meru taxi technology for authorickshaws so that authorickshaw drivers could use a GPS-based app to touch base with prospective customers. However, this app failed to take-off as initial pilots revealed that the illiteracy of autorickshaw drivers (both digital and language) prohibited them for using this technology effectively.

Make My Trip highlighted that there are solutions. There are people who, although not formally literate, are English aware. *Make My Trip* ensures 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, it is widely acknowledged that local language content is needed to increase the penetration of mobile apps throughout India.

Finally, apps should be relevant and easy to use. Mobile phones should be able to provide services that cater to BoP customers. High tech apps that require high literacy levels and knowledge of English would be ill-suited to the needs of rural India. **Rural India needs local language content, voice-based applications and easy interfaces that make the usage of mobile phone apps intuitive for the poor.** App developers need to bear in mind the constraints of illiteracy and make their interface such that it depends more on pictorial representation and audio tools (for example, Mobile Harvest is a literacy neutral app designed by Indian developers to cater to the needs of the BoP)**.**

6. The Way Forward

India should pursue two strategies to encourage the growth of its app economy. The first should focus on unlocking the potential of its domestic market through mechanisms that strengthen the absorptive capacity of the domestic app ecosystem to create content that addresses the unique socio-political and economic needs of India. The second strategy should focus on creating internationally competitive content that challenges established paradigms in the global app economy. The combination of these two measures, requiring both incremental and radical innovation and having both inward and outward-oriented aspects, could together constitute the necessary and sufficient conditions needed for the take-off of the Indian app economy.

The app economy is currently targeting the 'low-hanging fruits' i.e. it is catering the underserved urban market which typically demands popular international content and does not suffer from the major ecosystem constraints that characterise semi-urban and rural areas. However, once the urban market reaches saturation, the need for locally relevant content will emerge as this is what will drive adoption in the interior parts of India. The saturation of the urban market will also create the impetus for Indian app developers to create internationally competitive and innovative content such that users in urban markets gain access to even better and richer apps. The next two subsections evaluate how the Indian app economy can spread into the interiors through locally relevant content and how it can reach international competitiveness through new-found creativity.

6.1 Strengthening the Domestic App Ecosystem

Much of this paper has been dedicated to creating the necessary conditions for the app economy to take-off in the interior parts of India. This means that smartphones will have to start penetrating the rural segment, broadband penetration must rise and the policy environment should be made conducive towards increasing digital literacy and awareness, and helping nascent app markets develop through better innovation support and mobile-payment regulation. If this is in place, the next step, involves app developers, content aggregating media, OEMs and telecom operators working together to create, support and disseminate locally relevant content in regional languages. OEMs must ensure that they create devices that are affordable and which can support localised apps. Telecom operators could play a potentially pivotal role in facilitating the billing

of apps which will offer a way to circumvent the currently unfavourable mobile-payment regulation. The government could create a favourable policy environment and fund innovation in the mobile for development space such that apps that address issues of public concern get the requisite support. Finally, to ensure that content reaches its target audience, distribution platforms must be innovative and may even need to have physical presence as AppsDaily has demonstrated. At the user-end, consumers in the rural and semi-urban areas must be educated about the utility of apps. This would require aggressive and innovative marketing by the market as well as digital awareness and literacy schemes led by the government. In totality, to reach the interiors of India, the accepted fundamentals of app development, distribution and consumption need to be challenged such that they are tailor-made to suit the heterogeneous needs of the segmented Indian app market.

6.2 Reaching International Competitiveness

To create path-breaking internationally competitive apps, Indian app developers must first improve their user design interface but more importantly, challenge established paradigms in the app economy. The following case studies highlight some examples of how established paradigms have been challenged to give an indication of what Indian app developers can advance/learn from.

6.2.1 Apps that are like App Stores

LightApp, an initiative of the Chinese search engine Baidu, is an app that helps users find and use web-based apps more easily. It offers an alternative to the app store and gives users direct access to in-app content without needing to download the full app itself. To do this, it taps into Baidu's existing cloud services.[101]

For example, if a user posts a search query for a chess game, Baidu's LightApp will display all apps that can be used to play chess. Thereafter, the user can directly access in-app content through the web without having to download the app. This gives web-based apps a native feel and saves users the trouble of downloads.

[101] Bischoff, Paul. "Baidu launches Light App, an app that runs apps." TechInAsia. 22 August 2013. Web. 13 Feb. 2014. < http://www.techinasia.com/baidu-launches-light-app-app-runs-apps/>

The creators of LightApp believe that the app industry will evolve towards a more Google-like search-based model where content search within app stores will be similar to the web searches done through desktop computers. As Baidu says, 'Search will be a new tool to unlock the 'longtail'[102] of existing apps and to be able to find apps…that do not make it to the front pages.'[103]

6.2.2 Apps that allow a new level of customisation

Cydia, the alternative app store, caters to jailbroken[104] iOS devices. Cydia has over 22 million active users and has enabled many more developers to design for Apple. Cydia is a unique app store because it allows developers to do much more with the iOS system than what Apple permits. The creator of Cydia says that, '[Cydia is] an alternative not to the 'App Store,' but to the '"*App*" Store.' For example, Cydia's 'apps' are not only self-contained pockets of software but packages of code that allow users to perform powerful multitasking actions, access the iOS filesystem and customise the user interface in ways that Apple and many other operating systems prohibit. Cydia apps can run in the background and can change the way an Apple device fundamentally looks and functions. This is a potential revolution because what Cydia is, is much more than a platform that distributes bite-sized, self-contained software packages. It is a platform from where users can access software that can fundamentally changes the way their device looks and operates, and provides a new, previously unseen degree of customisation.

6.2.3 Apps that make previously paid services free

Another highly promising area for India is to design apps that make previously paid-for-services free. If one examines the most popular apps worldwide, they have typically have replaced a service that used to require regular payment (e.g. Skype has offered a free route to make calls, WhatsApp is replacing conventional text messaging). Indian app developers could look at designing similar apps.

[102] *Long tail apps – apps that are not so popular.
[103] Mir, Iris. "China's App Stores: The Battle for Mobile Share" 20 December 2013. Forbes India [New Delhi]. Web. 19 Jan. 2014
[104] Note: jailbreaking is officially legal.

6.3 Conclusion

To successfully engage in such innovation, international collaboration may be necessary. If Indian app developers start engaging in across-the-board collaboration and innovative development, they can unlock the full potential of the Indian app economy and it is likely that the economic impact in terms of job creation and service delivery will be profound.

The three most important issues identified are the low penetration rate of mobile broadband, lack of local app distribution platforms due to skewed revenue sharing models and lack of consumer awareness. If these three problem areas are addressed by implementing, among other measures, some of the ones outlined above, the Indian app economy has the potential to become a global player and enhance economic, business and developmental outcomes by delivering much needed services to Indian citizens. A robust app economy could herald the beginning of a new climate of innovation and digitalization for India.

Works Cited

1. Adler, Richard, and Mahesh Uppal. M-Powering India. Gurgaon: Aspen Institute India, 2008. Print.
2. "Android Fragmentation Visualized (July 2013)." Android Fragmentation Report July 2013. Web. 20 Jan. 2014. <http://opensignal.com/reports/fragmentation-2013/>.
3. AppFlood Network, Data from 2013.
4. "App showing salaries of different jobs goes viral in China." WantChinaTimes [Beijing] 4 Dec. 2013:.WantChinaTimes.com. Web. 13 Feb. 2014.
5. "Auction not sole route for allocation of natural resources: Supreme Court." The Hindu [Delhi] 27 Sept. 2013: Web. 10 Feb. 2014.
6. Bharwani, Prakash; Biswa, Sandip. Gupta, Gaurav et al. "Mobile Value Added Services (MVAS) - A vehicle to usher in inclusive growth and bridge the digital divide" (2011) Deloitte, ASSOCHAM.
7. Bilbao-Osorio, Beñat , Soumitra Dutta, et al. "The Global Information Technology Report 2013 Growth and Jobs in a Hyperconnected World." World Economic Forum & INSEAD. (2013): Web. 20 Jan. 2014. <http://www3.weforum.org/docs/WEF_GITR_Report_2013.pdf>.
8. Bischoff, Paul. "Baidu launches Light App, an app that runs apps." TechInAsia. 22 August 2013. Web. 13 Feb. 2014. < http://www.techinasia.com/baidu-launches-light-app-app-runs-apps/>
9. Chetan Sharma, Sizing up the Global Mobile Apps Market (2010). Web. 20 Jan. 2014. < http://www.chetansharma.com/mobileappseconomy.htm>
10. Crabtree, James. 'Reserve Bank of India moves to enhance mobile payments market' *The Financial Times* [Mumbai] 16 Jan. 2014: Web. 20 Jan. 2014.
11. Doron, Assa , and Robin Jeffrey. Cell Phone Nation, New Delhi: Hachette India, 2013. Print.
12. Galpaya, Helani, 2011. Broadband in Sri Lanka: Glass Half Full or Half Empty?. Washington, D.C: World Bank. Available at http://www.broadband-toolkit.org/.
13. "Global mobile app download revenue to touch $26 bn in 2013: Gartner." The Financial Express. 19 Sept. 2013. Web. 20 Jan. 2014. <http://www.financialexpress.com/news/global-mobile-app-download-revenue-to-touch-26-bn-in-2013-gartner/1171341>.

14. Government of India. Ministry of Science and Technology. Science Technology and Innovation Policy 2013. New Delhi: 2013. Web. <http://www.dst.gov.in/sti-policy-eng.pdf>.
15. Gupta, Deepali. "Microsoft turns to Bollywood to spruce up Apps store." The Economic Times [Delhi] 12 Dec. 2013: n. pag. The Economic Times. Web. 11 Feb. 2014.
16. Harlalka, Bikash. "India Mobile Landscape 2013 Topline." Telecom Watch, Web. 13 Feb 2014.
17. "IAMAI launches Apps Foundation for developers." The Times of India [New Delhi] 26 June 2013: Print.
18. "ICT for Greater Development Impact: World Bank Group Strategy for Information and Communication Technology." World Bank. (2012): Web. 13 Feb 2014.
19. IDC, Data from 2013.
20. "India among top five download regions for Amazon app store: Parag Gupta."Business Standard [New Delhi] 25 Nov. 2013: Print.
21. Kathuria, Rajat; Kedia-Jaju, Mansi. India: The Impact of Internet. IAMAI, Department of Information Technology, Government of India and ICRIER, 2011.
22. Kathuria, Rajat (et al). India: The Impact of Mobile Phones. Vodafone Group Plc and ICRIER, 2009.
23. Kathuria, Rajat. "The Next Stage of Telecom Growth." International Management Institute Magazine. (2011): 2-6.
24. Law, Abhishek. "Developing India's app market." The Hindu [New Delhi] 1 Aug. 2012: The Hindu Business Line. Web. 20 Jan. 2014.
25. Llamas, Ramon, Ryan Reith, and Michael Shirer. Android Pushes Past 80% Market Share While Windows Phone Shipments Leap 156.0% Year Over Year in the Third Quarter. IDC, 12 Nov 2013. Web. 13 Feb 2014.
26. "Making money in the free app economy." Business Standard. 4 Nov. 2013. Web. 20 Jan. 2014. <http://www.business-standard.com/article/management/making-money-in-the-free-app-economy-113110300460_1.html>.
27. "MDI Case Study - M-KOPA." GSMA Mobile for Development Intelligence. Web. 20 Jan. 2014. <https://mobiledevelopmentintelligence.com/insight/MDI_Case_Study_-_M-KOPA>.

28. Mandel , Michael , and Judith Scherer. "The Geography of the App Economy." CTIA: The Wireless Association. (2012): Web. 20 Jan. 2014. <http://files.ctia.org/pdf/The_Geography_of_the_App_Economy.pdf>.
29. "Maximizing Mobile." World Bank (2012): Web. 20 Jan. 2014.
30. Mir, Iris. "China's App Stores: The Battle for Mobile Share" 20 December 2013. Forbes India [New Delhi]. Web. 19 Jan. 2014.< http://forbesindia.com/article/ckgsb/chinas-app-stores-the-battle-for-mobile-share/36607/1#ixzz2vZ6uW5lf>
31. "MBit Index India Study." Nokia Siemens Networks (2013): Web.
32. "Mobile Usage at the Base of the Pyramid in Kenya." infoDev (2012): Web. 20 Jan. 2014.
33. Mulloy, Brian , and Kevin Swiber . "Ten Steps to Bring the App Economy to Enterprise IT." Apigee, 14 Nov. 2013. Web. 13 Feb. 2014.
34. 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>.
35. Nielson. Mobile Youth Around the World, 2010.
36. Open Signal, Data from 2013.
37. Pettey, Christy , and Rob van der Meulen. "Gartner Says Free Apps Will Account for Nearly 90 Percent of Total Mobile App Store Downloads in 2012."Newsroom. Gartner, 11 Sept 2012. Web. 13 Feb 2014.
38. "Scaling Mobile for Development: A developing world opportunity (Interim Report)." GSMA Mobile for Development Intelligence. (2013) Web. 20 Jan. 2014. <https://mobiledevelopmentintelligence.com
39. Schwab, Klaus, Sala-i-Martin Xavier , et al. "The Global Competitiveness Report 2011–2012." World Economic Forum. (2011): Web. 20 Jan. 2014. <http://www3.weforum.org/docs/WEF_GCR_Report_2011-12.pdf>.
40. Singh, Prashant Veer. "Changing the Landscape of Telecom Infrastructure (Whitepaper)." Bharti Infratel Limited. (2011): . Web. 20 Jan. <2014..http://www.bharti-infratel.com/cps-portal/web/pdf/Infratel-Whitepaper-TOC.pdf>
41. Smith, Aaron. "Smartphone Ownership — 2013 Update ." Pew Research Center (2013): http://pewinternet.org/. Web. 20 Jan. 2014.

42. "The opportunity and challenge of India's infrastructure." gridlines. PwC, (2013): Web. 20 Jan. 2014.
43. "The App Gap Index." The Economist Intelligence Unit. (2013).
44. TRAI Recommendations 2008: http://www.trai.gov.in/WriteReadData/Recommendation/Documents/AS140512.pdf
45. Quadri, A., Hasan Mehedi , et al. "Next generation communication technologies: Wireless mesh network for rural connectivity." GLOBECOM Workshops, IEEE. (2011). Web.
46. "Questions about the mobile consumer?."Our Mobile Planet. Google. Web. 19 Jan. 2014. <http://www.thinkwithgoogle.com/mobileplanet/en/>.
47. "What Is the Impact of Mobile Telephony on Economic Growth?' GSMA, CISCO, Deloitte. (2012): Web. 20 Jan. 2014.
48. "Why does Kenya lead the world in mobile money?" The Economist. 27 May 2013. Web. 13 Feb. 2014.
49. XYO Logic, Data from 2013.
50. "3G users in India to touch 272 million by 2017 from 35 million in 2012: Analysys Mason." TelecomLead. 21 June 2013. Web. 20 Jan. 2014. <http://www.telecomlead.com/3g/3g-users-in-india-to-touch-272-million-by-2017-from-35-million-in-2012-analysys-mason-38292/>.

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
16. PlayApps Inc.
17. IAMAI
18. The World Bank

Appendix

Exhibit 1: Research Methodology

The authors of this paper conducted semi-structured interviews with key players in the Indian App Economy ecosystem. The designation of these stakeholders was of the level of CEOs, directors or founders. Each interview was on average one hour long. Chain-referral was used to obtain further interviews.

Exhibit 2: Types of Mobile Devices and their Capabilities

Device	Capabilities	Device	Capabilities
Basic mobile phone	*Network services, including:*	Smartphone	*As Featurephone plus:*
	Voice telephony and voice mail		Video camera
	SMS (short message service)		Web browser
	USSD (unstructured supplementary service data)		GPS (global positioning system)
			3G+ internet access
	SMS-based services, such as mobile money		Mobile operating "platform" (such as iOS, Android, Blackberry)
	USSD services, such as instant messaging		Ability to download and manage applications
			VoIP (Voice over Internet Protocol)
			Mobile TV (if available)
			Removable memory card
Featurephone	*As basic mobile phone plus:*	Tablet	*As smartphone plus:*
	Multimedia Messaging Service (MMS)		Front and rear-facing video cameras (for video calls)
	Still picture camera		Larger screen and memory capability
	MP3 music player		Faster processor, enabling video playback
	2.5G data access		Touchscreen with virtual keyboard
			USB (universal serial bus) port

Note: The list of capabilities is not exhaustive, and not all devices have all features.

Source: Maximising Mobile, The World Bank

Exhibit 3:

Case Study - Make My Trip Consultation – "Information before Transaction"

Make My Trip has launched two apps named 'Make My Trip' which facilitates hotel and transportation bookings and 'Route Planner' which calculates the best method of getting from one city in India to another. Make My Trip views apps as an extended method of service delivery. Its apps are free to download and are primarily centred on delivering information. Make My Trip believes that since India is a 'mobile first' economy, mobile apps will enable Make My Trip to expand its base of consumers by reaching out to more people. This strategy is reflected in the platforms which Make My Trip targets –the Make My Trip app can be downloaded on any platform (of which Android is most used) and the Route Planner is designed specifically for the low-cost Nokia Asha.

The Make My Trip app has experienced two million downloads and 20 percent of total hotel booking are done via mobile devices. It has been found that a large proportion of the 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. The Make My Trip 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 Make My Trip services. The app relies on bookings made by consumers. However, the growth of mobile transactions is constrained due to mobile payment regulation which is not user-friendly. Due to the requirement of the One Time Password (OTP) delivered by SMS, users have to exit the Make My Trip 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 Make My Trip could consider routing payments through mobile services providers, it was found that due to the high costs of trips, mobile service providers would be wary of taking on the associated risk.

A short-term policy recommendation that comes out of this experience is that the mobile payment process should be simplified by eliminating the OTP and perhaps substituting it with another measure that does not require the user to exit the app. The long-term policy implication is that India should continue to increase its financial penetration.

Make My Trip'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 aspects such as, making the app functional across multiple platforms, are outsourced to companies. In Make My Trip's experience, it was difficult to access personnel who specialize in interaction design and more generally, 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 Sourcebits have experienced IT professional but charge around 50 lakh rupees for their services. This is out of reach for many parties.

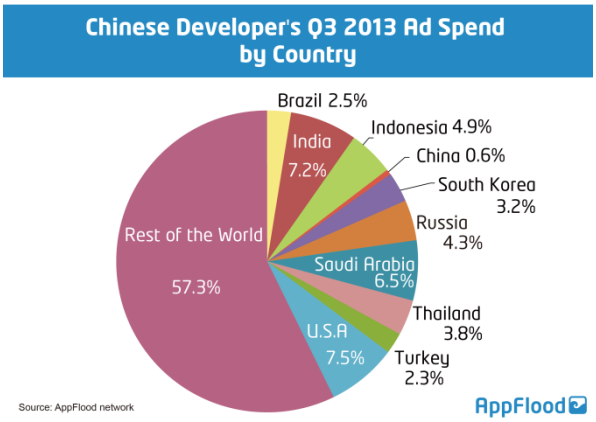
When asked if language is an issue which may prohibit app adoption, Make My Trip highlighted that there are people who, although not formally English literate, are nevertheless English aware. Make My Trip has ensured that it can cater to this segment of the population by using a Natural Language Processing 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, Make My Trip 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.

Exhibit 4: China Expanding Internationally

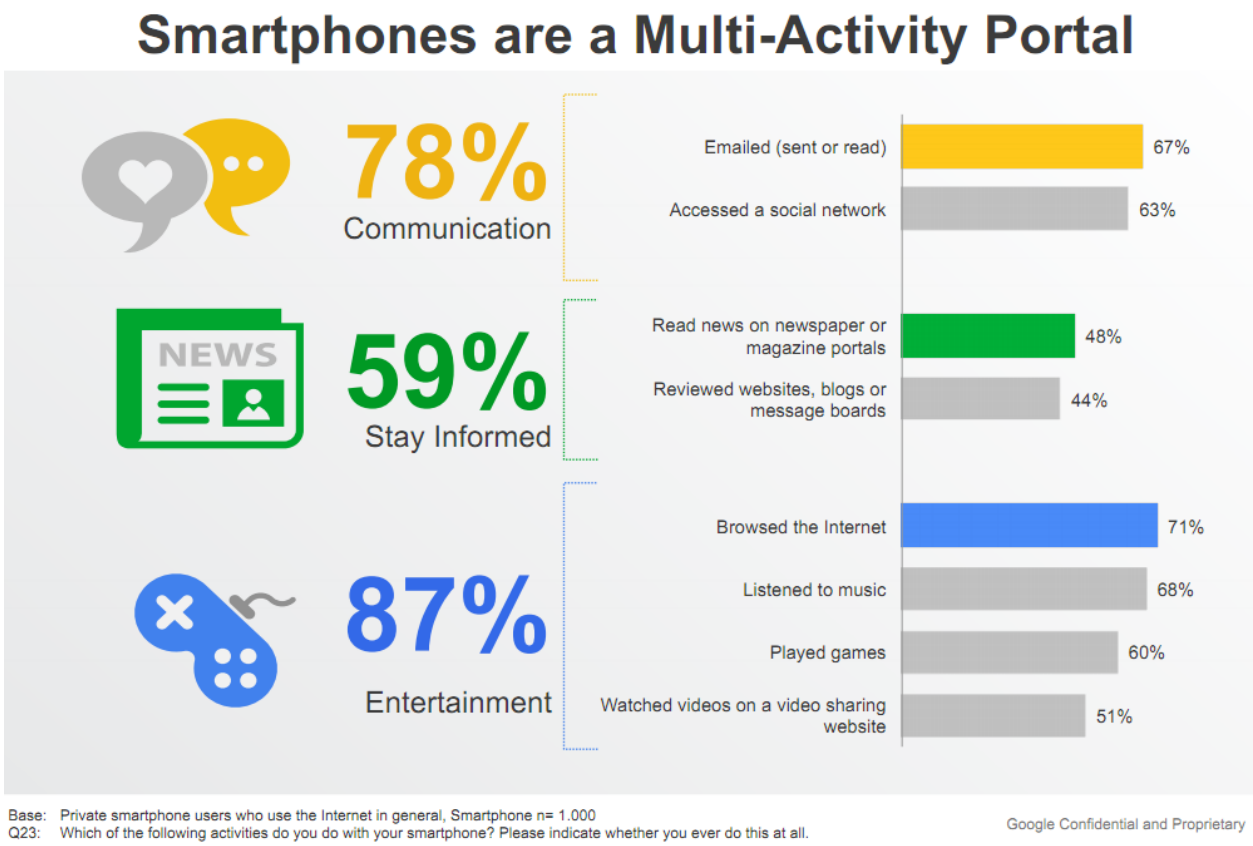
AppFlood's mobile advertising network shows that the percentage of traffic purchased by Chinese mobile advertisers was the most (38 percent) and it surpassed what U.S. mobile advertisers purchased in Q3 2013. It also shows that Chinese advertising efforts were outward-looking as only 0.6 percent of the total expenditure was directed to China. 'China's efforts were successful as 55 percent of mobile users on AppFlood's network were acquired by Chinese developers, while the U.S. managed to purchase just 10 percent of total users.'

‘Chinese tech giants invested the largest chunk of their budget into acquiring Asian users – as much as 33 percent of the total budget – and note that a miniscule 0.6 percent of Chinese devlopers’ budgets went into China.’



China Looking Towards South East Asia and Middle East

Exhibit 5: What Smartphones Are Used for in India



Source: "Questions about the mobile consumer? "Our Mobile Planet. Google.