# CREATING A SUPPORTIVE ECOSYSTEM FOR INCUBATING RURAL TELECOM VENTURES IN INDIA

To be presented at:
China-India-US Symposium Series on Development and Governance
Indian Institute of Management, Bangalore, India
January 22, 23, 2011

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**Acknowledgements**

This paper is based on an unpublished report titled "Addressing the Challenges of Telecom Entrepreneurship in India", that we developed for the IIMA IDEA Telecom Centre of Excellence. We gratefully acknowledge the support provided for this research by the Department of Telecommunications and the Coordinating Centre, Telecom Centres of Excellence, India. We offer our personal thanks to Commodore J. Jena for taking the lead to help concretize this research idea.

We thank all the entrepreneurs and incubator heads and staff members that we interviewed, for facilitating and enriching our fieldwork.

We appreciate the valuable research assistance provided by the IIMA-IDEA Telecom Centre of Excellence staff, Mr. Puneet Tiwari and Ms. Neha Roy. We are especially grateful to Mr. Puneet Tiwari, Research Associate, IITCOE, for his research support and contribution to the project management.

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## ABSTRACT

Of India's 580 million cell phone users, a disproportionate number is in urban areas. The country's objective of inclusive growth would be easier to achieve with greater penetration of rural telecom usage and provision of innovative telecom services especially tailored for rural India.

This paper examines how conditions can be created to incubate new ventures that focus on innovation and entrepreneurship targeting rural telecom. It draws on field interviews conducted in India and the US to study factors that foster high-tech incubation in general, and the special challenges presented by incubation for rural telecom in India. It discusses how the government can assist in successful incubation of rural telecom ventures by developing focused rural telecom incubators and by more general measures to strengthen the environment for innovation and entrepreneurship.

## CREATING A SUPPORTIVE ECOSYSTEM FOR INCUBATING RURAL TELECOM VENTURES IN INDIA

Telecom services play a critical role in economic growth along with other services related to information and communications technologies (ICT). With greater provision of ICT enabled services, both by governments and the private sector, the role of telecom services in the economy has become even more important. Previous research in different parts of the world (India, Pakistan, Philippines, Thailand, Sri Lanka, Peru, Tanzania, South Africa and Egypt) found that users of telecom services, especially mobile phones, including those at the Bottom of the Pyramid (BOP) reported important social impacts, which in some cases have been transformational (Jain & Sarin, 2009). Given the beneficial developmental effects of telecom services, governments have attempted to focus on how to accelerate their adoption by the poor, especially in rural areas.

While on one hand, telecom services have potential to bring in greater equitable development, competitiveness in the telecom sector is recognized as an important driver of economic growth across nations. R&D and innovation play a crucial role in the growth of the sector as the underlying technological changes in the sector are rapid. The following exemplifies the concerns with competitiveness of the telecom sector at the national level:

> *"The United States faces strong and growing competitive pressures from nations that are making significant investments in telecommunications R&D. .....China, Japan, Korea, and member states of the European Union have identified telecommunications as a strategic area for economic development"* ( Lucky & Eisenberg, 2006).

> *"The health of the U.S. telecommunications sector depends on maintaining leadership innovation"*
>
> -Committee on Telecommunications Research and Development, National Research Council, USA, 2006

Since innovation is important both for penetration of service provision and competition, start-ups are vital elements in the innovation and entrepreneurial efforts.

They contribute to knowledge creation and development of intellectual property and consequent new product/service development, job creation and service delivery in the sector. For start ups to flourish and contribute to the sector growth and competitiveness, an innovation ecosystem at the national/sectoral level is necessary. Incubators are an important part of this ecosystem. Many developed nations and some developing countries have established programs for supporting entrepreneurs and incubators.

Most developed nations, despite their focus on the private sector for development, recognize the role of public funding for R&D in the telecom sector and have developed plans and programs for supporting R&D in general and start-ups in particular. The Small Business Innovation Research (SBIR) program and National Science Foundation (NSF) are two examples in the USA of support for innovative small business enterprises. Universities are emerging as centres for such research. NSF supported Engineering Centres in the USA, the UK Research Council, Centres of Excellence in the Netherlands, and various universities in China are examples of public funding for telecom research.

Further, since start-ups in the telecom sector have specific requirements (such as access to specialized equipment and test-beds), there is a greater need for public funding support for incubation centres, especially in developing countries where innovation ecosystems are poorly developed (Scaramuzzi, 2002; Lalkaka, 2002). In India, there are no national policies or programs for supporting telecom R&D or entrepreneurship. Also, there are few established incubators as part of any national initiative. As a result, innovators and entrepreneurs find it challenging to sustain and commercialize their efforts. Often they do not patent or copyright the product/process, whereas similar innovations (handsets, base stations), from other parts of the world get incorporated in to commercial products/processes. When Indian service providers use such products they have to pay royalty/licensing fee, resulting in a net outflow of foreign exchange.

**Why Rural Telecom?**

Cell phones are among the products that bring swift and substantial benefits to the poorest segments of society. Unfortunately, while they are rapidly penetrating the base of the pyramid, rural usage is well below urban levels. Countries like India, that are attempting to spread the benefits of rapid growth to economically weaker segments of society, more than 60% of whom reside in the country's 640,000 villages, could achieve

their equity objectives faster with measures to specifically promote mobile service use in rural areas. The growing disparities in telecom service penetration (highlighted below) and the consequent impact on potential for development is a cause of concern for policy makers.

**Indian Telecom:** India's telecom sector is growing at a blistering pace with about 20 million new cell phone subscribers being added each month (Telecom Regulatory Authority of India, 2010a). Overall, teledensity increased in India from 33.2% as of December 31, 2008 to 43.5% as of December 31, 2009. However, this growth was largely concentrated in urban areas. In the last 10 years, the difference between rural and urban teledensity worsened significantly, from 6.3% on March 31, 1999 to 89.7% on December 31, 2009 (Telecom Regulatory Authority of India, 2010b; DoT, 2009; Vodafone, 2009). The reason for this is that the dramatic growth in telephone connections is accounted for by cell phones, which are penetrating urban areas more rapidly than rural ones. The rate of rural penetration is slow because of high cost of service provision. Since the population is spread out over a large area the cost of equipment deployment is high. Low rural population density also raises cost of service provision. Rural customers' lower ability to pay vis-à-vis urban areas makes the commercial viability of such services difficult. While there are isolated examples of innovative solutions to these problems, there is a need to develop a concerted national effort to address this problem.

**Need for Innovation**

Innovative technological and business solutions are necessary to address challenges presented by developing countries condition, such as erratic electricity and low levels of literacy, which require greater focus on audio and visual rather than textual interfaces. In addition, India has a large number of languages; hence, interfaces need to be developed for multiple languages. Start ups can be especially important in developing such innovations. However, since telecom start ups have special needs and require access to expensive infrastructure, public funding is necessary.

**Literature Review**

We briefly review the relevant literature on start-ups and incubation.

**Start-ups:** In high-technology and knowledge-intensive sectors, start ups contribute significantly to economic growth, and are major sources of innovation. New

ventures, especially high-technology new ventures, have received wide recognition for their contributions to the economy (Drucker, 1985; Hayton, 2005). In comparison to large established firms, new, small firms grow faster (Evans, 1987a; Wagner, 1994; Cabral, 1995; Tether and Massini, 1998; Brixy and Kohaut, 1999), create more net jobs (Robson, Gallagher, and Daly, 1993; Kirchhoff, 1994; Hart and Oulton, 1999), distribute wealth more effectively (Schumpeter, 1942), and innovate more (Chakrabarti, 1991). Empirical results indicate that an increase in innovative start-up activity is more effective than an increase in general entrepreneurship for economic growth (Meuller, 2007). In the last 25 years, two-thirds of the net new jobs and 95% of the radical innovations in developed markets like the US and UK have come from these high-tech new businesses (Allen, 1989; Timmons and Spinelli, 2003).

Start-ups, especially those in the high-tech sectors, not only face harsh business environment as other start-ups do, but face significant additional challenges. To develop products and services, they often need access to expensive equipment and test beds, which, if not publicly available, makes it difficult for them to develop quality products and services. These firms operate in an extreme environment where the technological challenges are immense and the available resources generally scarce (Julien, 1995). They are commonly characterized by high costs for R&D, decreasing product and technology life cycles and strong competition from foreign firms (Porter, 1986; Kobrin, 1991). In the high-tech sector, business survival, let alone growth, is dependent on finding and exploiting a reliable innovation strategy quickly, and before other firms enter the market (Park, 2005).

**Incubation:** A large body of literature has emerged on the topic of incubation, which is a key factor in innovation. A systematic review of the various studies (Hackett and Dilts, 2004) indicates that business incubation research has focused on incubator development (Kuratko and Lafollette, 1987; Sherman and Chappell, 1998), incubator configuration (Smilor and Gill, 1986; Hisrich, 1988), incubatee development (Stuart and

Abetti, 1987), incubator-incubatee impact ( Allen and McCluskey, 1990; Udell, 1990) and studies theorizing incubator-incubatee relationships (Williamson, 1978; Brooks, 1986). Incubator development studies have focused on taxonomies of incubators by business focus, such as product development, manufacturing, and mix-use (Plosila and Allen, 1985), sources of financial funding, for example, publicly-sponsored or university-sponsored (Kurato and Lafollette, 1987; Temali and Campbell, 1984), and type of incubatee, for example, spin-off or start-up (Plosila and Allen, 1985), with a view to making a comparative assessment of their performance. However, few studies have been able to predict variations in performance outcomes based on these variables (Hackett and Dilts, 2004).

Incubator configuration studies have focused on critical success factors for incubators and the underlying management processes (Smilor, 1987; Merrifield, 1987). Studies have shown that having a proper selection process (Kuratko, LaFollette, 1987; Merrifield, 1987), an internal incubator network (Lichtenstein, 1992), incubator-industry network (Hansen et al, 2000; Nowak and Grantham, 2000) and procedural standardization and policy formalization (Bears, 1998) contribute to incubator effectiveness (Sherman and Chappell, 1998) and determine the level of incubator development (Allen, 1988; Sherman and Chappell, 1998).

While there are a large number of studies focusing on impact assessment (Udell, 1990; Bearse, 1998), measures of incubation (Campbell and Allen 1987), incubatee success (Allen and Weinberg, 1998), and impact on community, there are few studies that focus on how incubatees develop within the incubator. Further, a variety of approaches have been used to theorize about incubator-incubation relationship such as structural contingency theory (Ketchen, 1993), interdependent co-production modeling (Rice, 2002), and network theory (Nohria and Eccles, 1992).

The role of university linkages is critical for incubation in the knowledge-intensive domain (Mian, 1994). Apart from providing necessary infrastructure support for nurturing firms, universities provide networking opportunities within the ecosystem, which are essential for success (Freel, 2003; Hansen et al., 2000; Johannisson, 1988; Tse, 2002; Rothschild and Darr, 2005).

The relationship with developed economies can stimulate faster knowledge creation along with technology transfer (Ernst, 1998; Borrus, 1997; Dedrick and Kraemer, 1998). International networking can help the incubator reach VCs, who might, potentially, fund its incubatees. Also, such transnational communities can assist in industrial upgradation and collaboration between individuals (Saxenian, 1999). These collaborations can be vital for the long term success of incubators (Lavrow and Sample, 2000). At the macro level, such linkages with the developed economies can lead to improved domestic capabilities of entrepreneurs (Ernst, 1998; Borrus, 1997; Dedrick and Kraemer, 1998).

The government is a key participant in the innovation ecosystem. The triple Helix model (Etzkowitz and Leydesdroff, 1996, 1997, 2000) has identified the importance of government, university and industry in developing innovation systems. According to the US Council of Competitiveness, the interlinking of these three sectors not only provides support to incubators but also assists them in gaining competitive advantage while helping diffusion of information (Marques, Caraca, and Diaz, 2006).

The factors identified above need to be kept in mind while developing elements of an ecosystem for incubating rural telecom ventures in India.

**Research Objective and Design**

The objective of this study was to examine how conditions can be created to incubate new ventures that focus on innovation and entrepreneurship targeting rural telecom. We started out by trying to map the Indian innovation landscape (section 2) and comparing it with the innovation environment in Cambridge, Massachusetts, USA (section 3), which is regarded as providing an especially nurturing environment for high-technology innovation and start-ups clustered around MIT. This allowed us to define a role for rural telecom incubators in India and how the government might make them effective (section 4). We also present general measures to support rural telecom innovation (section 5).

**Method** Our study draws on field interviews conducted in India and the US to study factors that foster high-tech incubation in general, and the special challenges presented by incubation for rural telecom in India. In order to understand the challenges of new telecom start-ups in a holistic manner, we studied issues from the perspective of

different industry stakeholders. We interviewed a total of 31 persons who manage incubators, entrepreneurs and angels. We interviewed 15 incubation managers, 14 entrepreneurs and 2 angel investors (See table 1.)

**Insert table 1 about here**

This paper is based on both primary and secondary research. We reviewed academic research papers in leading journals focusing on incubation. For the primary research, we examined both publicly and privately funded incubators and focused on incubatees who were working in both IT/telecom products and services and other emerging technology areas. We studied the following incubators:

i. Indian Institute of Technology (IITD), New Delhi, India
ii. Rural Technology Business Incubator (RTBI), Indian Institute of Technology, Madras (IITM),Chennai, India
iii. Indian Institute of Science (IISc), Bangalore, India
iv. ICICI Knowledge Park (IKP), Hyderabad, India
v. Indian Institute of Information Technology, Hyderabad (IIITH), India
vi. Tata Consultancy Services Co-Innovation Network (TCS COIN), Mumbai, India
vii. Cambridge Innovation Centre (CIC), Cambridge, USA

An overview of these incubators' scope and objectives is provided in Appendix 1.

We conducted primary research with a set of telecom ventures that had been incubated in India (and selected ones in the US) to highlight incubation processes, perceived benefits, technology development challenges (such as lack of access to standardized test-beds) and broad expectations from a telecom-specific business incubation centre. The project team spent substantial time with incubation teams to understand the environment, challenges, bottlenecks, aspirations and capabilities needed in telecom ventures to ensure market success.

## INDIAN INNOVATION LANDSCAPE

### Government Role

Rural populations are more difficult for companies to access and engage than urban consumers for a number of reasons (Vachani and Smith, 2008). Given the enormous contextual challenges that deter the market from responding adequately to the need for

rural telecom innovation, it is important for governments to play a role in fostering innovation.

**Poor market information:** Entrepreneurs who want to develop products for the telecom sector find it difficult to fine-tune offerings for deployment in rural areas as there is little data on demographics and socio-economic aspects of the rural population to support need identification and business plan development. Inadequacy of fine-grained socio-economic and demographic data about rural markets is a roadblock to understanding the dynamics of the rural telecom market. Entrepreneurs are not able to get an in-depth view of the profiles of their prospective markets partly because no such repository of data is available.

**Capital intensive testing** Being technology intensive, telecom requires significant investment for development of new network technologies such as WiMax and 4G. Product testing is expensive owing to high cost of test equipment, which may be difficult for entrepreneurs to access. Once a product is developed it is difficult to get customer (service provider) access. There is a considerable size difference between start-ups and network operators, who are large. Access to testing infrastructure of large companies in the developed-country market is a further constraint facing new players, limiting their opportunities for foreign markets. Therefore, entrepreneurs do not generally focus on development of hardware solutions and network components, as they require large capital, and funds availability in the sector is low. This creates a need for government funding.

**Linkages with Rural/Government Departments** ICT platforms are being considered for delivery of a range of services such as banking, and disbursal of government grants and pensions. Many of these require interfacing with rural institutions run by the government. For example, under the National Rural Employment Guarantee Scheme, government departments employ rural people in their development projects and maintain beneficiary lists to make payments. These would need to be accessed by the service provider to implement a mobile based payment system for the beneficiary.

**Current government support**

While the Indian government supports creation of rural infrastructure through the Universal Service Obligation Fund[1] (USOF), there is little support for developing products and services targeted at rural areas. Of late, USOF has introduced support for pilot projects specifically designed for rural areas.

In relation to support for entrepreneurship, and specifically that related to the telecom, this is very little, especially when compared with countries such as China and Finland. The Chinese government started the "China 863" program or State High-Tech Development Plan to develop and test new technologies. Chinese state-owned-enterprise, Datang Telecom with assistance from Ministry of Information Industry (MII) and Siemens, developed one of the three international standards of 3G networks, also known as TD-SDMA. The momentum created by this indigenously developed telecom standard helped the creation of largest and diverse 3G and 4G test-bed in China. (Fonow,2006). Telecom developments in Chinese telecom sector will possibly facilitate Chinese population to access low cost telecom services. Finland, like China has invested in public telecom infrastructure support for entrepreneurs. It has identified telecom technologies testing as a major market in the future. 3G, WLAN, WiMax test-beds like Octopus located at Oulu near Helsinki is an initiative of the city of Oulu, Finland. While the testing services are being provided by Octopus Network, administrative services are being provided by Oulu Innovation Limited. Other test-beds like Converging Networks Laboratory is operated by a research organization, VTT Technical Research Center, which is a private contract research organization in Finland. A combination of public and private resources is being utilized for cutting-edge development in the sector.

[1] *USOF is a fund created by the Indian Telegraph Amendment Act, 2003 to provide telecom access in rural and remote areas. Telecom operators contribute 5% of their revenues to this fund annually. The fund is administered by the DoT and the annual budget of USOF is approved by Ministry of Finance.*

**Need for Incubators**

Typically, start-ups lack finance and management know-how. Incubators can provide the support ecosystems for successful telecom start-ups. In the context of the increasing role for the public sector in research and the objective of developing innovation capability, incubators supported by academic institutions, government and industry can serve as instruments for furthering innovation capabilities in the telecom sector.

Incubators provide both tangible and intangible support for start-ups. While they are a critical resource, not all are successful. Given that public resources are expended to support start-ups, a key question is how can incubator processes be aligned to attain success? In this context, various contributing factors include the importance of "supporting/complementary" capabilities (other than innovativeness and feasibility) in incubators (Maital et al., 2008). Incubators that fail to provide such capabilities may have unsuccessful incubatees despite careful selection of innovative and feasible projects.

Different models of incubation are driven by a variety of underlying factors including the driver for their inception, their objectives and constraints, nature of services provided, whether they are located in universities or are private or public enterprises, sectoral characteristics (technology change rates, cost of equipment, cost of developing new products, target customers) and their ability to target different client companies.

## The Telecom Innovation Environment in India

We examined the leading high-technology incubators in India with the objective of understanding the structure and functioning of these important institutional assets and trying to define the relationship between their drivers, scope of activities, nature of processes, and suitability for supporting start-ups with special needs. We used the framework in figure 1 to undertake our study.

**Insert figure 1 about here**

**Drivers and their Effects**

**Drivers:** Most incubators we studied were part of India's top-ranked science and technology institutes, the IITs (Indian Institutes of Technology) and IISc (Indian Institute of Science). An important driver for their creation was to derive value from

knowledge generated at the institute by transforming it into commercial applications. These incubators were captives of the institutes and designed primarily, if not exclusively, to serve their needs. The ICICI Knowledge Park, a private-public partnership, specifically focused on Life Sciences, was an exception. It was set up to facilitate development and transformation of knowledge created at other institutions into commercial applications. The process could entail further research and development, which could be performed at ICICI Knowledge Park. TCS COIN is a network of institutes, led by TCS.

**Posture:** Incubators that focus primarily on commercializing knowledge from an institute do not have to be owned and managed by that institute, although the ones we studied in India were. The Cambridge Innovation Center (CIC) in the US, which supports start-ups trying to commercialize technology generated at MIT, and is located at the fringe of the MIT campus, is privately owned and managed. The institutional separation from MIT aids CIC in creating a market-driven culture. Its start-ups, which pay market rents and are funded by angels and VCs, are forced to conserve resources, try and stay close to the market, and continually aspire to demonstrate value potential so as to secure later-stage funding. We felt that this ***market-oriented posture***, where the incubator and its start-ups are forced to face the market (not just for products and services, but also for capital) and be answerable to it, created pressure to succeed that was not easily achieved in incubators with an ***institutionally-oriented posture***, where start-ups did not need to begin by convincing angels and VCs of the commercial attractiveness of the venture.

**Scope:** The breadth of knowledge created at the academic institute provided an upper bound to the scope of the incubator's activities; for example, the scope of the incubator at IIITH (International Institute of Information Technology, Hyderabad) was limited to information technology consistent with the narrowly defined focus of the parent organization. The incubator's scope could, of course, be considerably narrower than that of the parent; thus, for example, at IIT Madras, the incubator focused on telecommunications and information technology while the parent's technology focus is much wider. Within the bounds defined by parents' scope,

incubatees' scope was a function of the circumstances in which the incubator was set up and the interests of the individuals who engineered its creation.

Incubators also varied in geographic scope, with few focusing on rural areas. Figure 2 maps the position of the incubators in terms of scope of technology and geography.

**Insert figure 2 about here**

**Facilities** All incubators provided basic services in varying degrees, such as office space, computers and administrative and web support. Other professional services like those of chartered accountants and company secretaries were also provided by most of the incubators through their network of legal and financial service professionals. However, there were significant differences in the specialized resources they offered and this was affected by their drivers and scope. For example, the incubator at IIT Madras, given its rural focus, provided access to a database for rural markets of Tamil Nadu, which it had developed itself. This database contained information on weather, crops and occupation at the village and district level. Such detailed databases were usually not available in the market. ICICI Knowledge Park, in addition to providing convenient access to wet laboratories that are expensive and difficult to set up and maintain, gave start-ups domain-specific legal support through patent attorneys familiar with the biotech industry.

**Governance and Management Processes**

**Governance processes:** The drivers also affected critical governance aspects. One of these was the selection of the incubator's CEO, which can have a direct impact on the incubator's effectiveness (Callegati, Grandi and Napier, 2005). Incubators that were a part of the university set-up tended to select faculty members as CEOs. However, in general, business incubators staffed by personnel with private-sector business experience have been found to have better relations with VCs, which, in turn, can facilitate start-up funding (Callegati, Grandi and Napier, 2005).

Equally important was the choice of the governing board and selection committee, as they provide overall policy-level guidance for incubators. Independent entities were normally operated through governing boards, while selection committees were preferred for incubators that were a part of the university setup, where it was not possible to have a governing board. The governing board and selection committees normally consisted of

the incubation manager, internal faculty technical experts (for those incubators that were in technological institutes) and external experts (chosen from faculty members of academic institutes, probable investors, experienced entrepreneurs, industry experts from related disciplines and financial institutes).

**Management processes:** Of the many management processes there are two that are especially critical for start-up success and are significantly affected by the drivers and posture of the incubator: mentoring and networking

Incubators provided advisory services on management issues like restructuring of teams, addition of professional management expertise and exit processes. Advice was also provided on structuring of financial deals with customers (licensing and technology transfer terms, pricing) and potential investors. They also helped in matching solutions developed by start-ups to market needs. Such assistance often involved review ranging from technology solutions to business solutions and leveraging of intellectual property rights. Incubators with a market-oriented posture are more likely to attract talented and experienced angels, VCs and serial entrepreneurs, resulting in more robust mentoring and networking opportunities. They are also likely to have tougher review processes.

## COMPARATIVE INNOVATION ENVIRONMENT: INDIA & US

There are a number of important differences in the environment for innovation and successful commercialization through start-ups between the US and India.

### Research Universities

The research university has become more engaged in the venturing business by more actively promoting technology transfer and commercialization (Smilor and Matthews, 2004). In the US, a number of factors such as rise in venture capital, the Bayh-Doyle Act (providing incentives for universities to patent breakthrough technologies accomplished through federal funding), mobility of scientists, and demand for greater innovations from the industry have contributed to the emergence of universities as contributing to the commercialization of research. Similar factors have operated in Europe (Rothaermel, Agung and Jiang, 2007).

Empirical work highlights the critical importance of a research university that can serve as " instigator; promoter; collaborator; and magnet for talent, technological

innovation, and entrepreneurial activity*"* (Rogers & Larsen, 1984). Several studies provide evidence that the nucleus in the development of a technology center is a research university as has been the case with Stanford, University of Texas at Austin, University of California at San Diego, University of North Carolina−Chapel Hill, North Carolina State University in Raleigh, and Duke University in Durham (Rogers and Larsen, 1984; Smilor, O'Donnell, Stein, and Welborn III, 2007; Rotherermel, Agung and Jiang, 2007) and Cambridge University (Wicksteed, 1985; Stam and Garsney, 2009). Other studies have shown that if a research university is not in place, a technology center is not likely to develop (Smilor, O'Donnell, Stein, and Welborn III, 2007). Smilor, Kozmetsky, and Gibson (1988) identified three main factors necessary for the development of a technology center in which the university plays an important role: (a) achievement of scientific excellence, (b) development and maintenance of new technologies for emerging industries, and (c) attraction of major technology companies and creation of home-grown technology companies.

These studies indicate that successful research universities are able to bring together business, government, and academia around a common goal through funding of research and infrastructure, such as specialized labs. Despite the outstanding brand and reputation of many Indian universities there are few that rank highly among the world's top universities for science and technology. With greater emphasis on cutting edge research and market-oriented development there could be more opportunities for innovation. These could be improved with changes in performance measures and provision of a facilitating ecosystem for innovation and entrepreneurship.

**Technology Transfer Mechanisms**

Leading edge research does not, in itself, spawn innovative start-ups. Research must be moved out of labs and packaged and presented to potential entrepreneurs, angels and VCs to pique their interest and enhance chances of building teams of seasoned entrepreneurs and securing seed funding. Even in the US, research universities are struggling to commercialize technology by moving it into start-ups. One of the reasons for MIT's success with commercialization is the technology transfer mechanisms it has created; for example, the Deshpande Center for Technological Innovation which helps

"emerging technologies to emerge" by funding innovative early-stage research and helping connect researchers with the business community.

In a move to leverage the commercial benefits of university research, several research universities in Europe and America have set up Technology Transfer Offices TTOs) and the tremendous increase in their numbers indicates the growing interest in this area. (Seigel, Veuglers and Wright, 2007). Further, TTOs are increasingly focused on the start-up dimension of technology transfer. The culture and strategy of universities may influence the extent to which it supports start ups. Further, these TTO have evolved sophisticated processes and incentives to strengthen start ups (Link and Siegel, 2005).

Like many institutions around the world, Indian universities are at early stages of development with regard to effective technology transfer mechanisms. There is significant learning and research on the experiences of TTOs in terms of their processes and relevant incentive mechanisms. In contrast to the extremely small number of institutions and universities that recognize the role of technology transfer and commercialization in the innovation process, an extremely large number of universities have not given thought to these developments, seeing themselves primarily as degree granting institutions. This is partly a result of the culture, which is more "rule bound" than supportive of innovation, lack of financial resources and vision. In order to leverage research, universities need to adopt a *strategic approach* to the commercialization of IP and design appropriate recruitment, retention and IP incentive systems.

**Variety of Mechanisms to Support Entrepreneurship**

In a bid to get the advantages of university based research in the commercial domain, universities have experimented with a variety of organizational forms: internal approaches, quasi-internal approaches (e.g., incubators), university research parks, regional clusters, academic spin-offs and start-ups, licensing, contract research and consultancy (Gideon, Siegel and Wright, 2008). In India, since commercialization from research is limited to a few universities and institutions, there are limited mechanisms, such as incubators and industrial consultancy, especially in the high-tech and telecom sectors. There are almost no specialized (sector) oriented research parks or regional parks as is the case in many developed countries. (ICICI Knowledge Park was an exception and it is too early to judge its success.)

**Entrepreneurship Clusters**

In many cases, entrepreneurship clusters emerge in regions around world-class research institutions that have been able to encourage technology-transfer out of universities. Some of the areas where there are significant technology-based start-ups are clustered around leading universities such Cambridge University in the UK, and MIT and Stanford in the US. Studies of innovation based technology start ups in Japan indicate that technological capability, the availability of internal funds, venture capital funding, and university–industry linkages are important firm-level determinants of innovation. While Breshnahan, Gambardella and Saxenian, 2001) argue that it is the availability of skilled labour rather than the presence of a high-quality university that contributes to clusters with high economic value, the presence of such a university is helpful.

Other critical elements in the formation of clusters are presence of complementary skills, access to markets, firm building skills and managerial skills. Researchers argue that entrepreneurs are a critical element in the formation of clusters as complex adaptive systems (Feldman, Francis and Berkovitz, 2005), where the external resources associated with clusters are developed over time. This was highlighted to a limited extent in the case of ICICI Knowledge Park, where the cluster initially started with infrastructural facilities, but has extended its services to include support for developing and protecting patents and testing as new firms in the cluster evolved to require those services. While there are a few clusters that have been successful in India, for example, Tirupur for textiles (Roy, 2009), and Bangalore, Pune and Chennai for software (Dayasindhu, 2002), telecom clusters have not emerged.

**Comment [r1]:** **'Old Economy' Inputs for 'New Economy' Outcomes: Cluster Formation in the New Silicon Valleys**
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**Comment [r2]:** **Old Economy' Inputs for 'New Economy' Outcomes: Cluster Formation in the New Silicon Valleys**
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**Robust Venture Capital**

One of the critical differences in the Indian and US environment for start-ups is the relatively abundant availability of venture capital in the US. Angels and venture capitalists are available and willing to work with promising start-ups to develop value propositions, overcome technological challenges, hedge risks and develop markets. This varies a great deal across the US with the most supportive environment being provided by the San Francisco Bay area, followed by Cambridge, Massachusetts. Indian entrepreneurs complained of the lack of interest from venture capitalists and difficulties in finding early-stage investors.

**Private Sector Incubators**

The availability of private-sector incubators is another factor that differs between the US and India. While there are some Indian private-sector incubators (such as ICICI Knowledge Park and TCS COIN) the number is fewer than in the US. In addition to Cambridge Innovation Center, which we included in our study, some others are: Idealab (Boston, New York and Silicon Valley), HOTVentures (Arizona) and i-Hatch (New York). Private-sector incubators, with their market-oriented posture, have more stringent expectations with regard to incubatees' pace of movement toward later stages and commercialization. They are also more likely to be firm in forcing incubatees to exit when they are stagnating.

## CREATING EFFECTIVE RURAL TELECOM INCUBATORS IN INDIA

The government can assist in successful incubation of rural telecom ventures with measures in a number of areas where needs are not adequately addressed by the market. Some of these measures can be implemented through a special rural telecom incubator (or multiple incubators of this kind). These include providing access to special resources such as testing facilities and rural market databases. The impact of such a focused incubator could be enhanced by leveraging networks of institutions that provide greater rural reach on and access to cutting-edge telecom technology. Given the institutional shortcomings of the innovation environment, the incubator's effectiveness could be strengthened by government assistance in seed funding, emphasizing market tests for incubatees' ideas and developing linkages with large companies that have developed robust platforms for accessing rural markets.

**Rural Telecom Incubators**

Special characteristics of technology, geography, or institutional environment can result in conditions such that it may be helpful to create incubators with special focus on a segment. Life sciences and telecom are examples of areas that require special, capital intensive, resources and specialized knowledge. In addition, rural markets have special needs for products and services owing to differences in user characteristics and environmental conditions. Lack of telecom sector focused elements in the innovation ecosystem limits its usefulness for telecom entrepreneurs, who may be unaware of the

range of assistance being offered by the government or other agencies. Given these special characteristics of rural telecom incubation it would be helpful to develop incubators with a special focus on the area. Such incubators can institute appropriate mechanisms to reach entrepreneurs and supplement mentoring on generic management topics with specific issues pertaining to telecom entrepreneurship.

**Telecom testing facilities** Access to telecom test beds would be one of the special advantages of a focused incubator. Such access is important as telecom start ups do not have the bandwidth to work with large companies in whose networks they would need to test products. If start ups use emerging technologies for product development, such as 4G, access to appropriate test facilities is especially important.

**Rural market data:** Given the lack of essential data about rural markets in general and rural telecom usage and needs in particular, one the ways in which the rural telecom incubator can assist start ups is by developing rural market data. It could define special data needs associated with rural use of telecom services and attempt to map differences in user conditions and needs across districts and states.

**Leveraging Through Rural & Technology Networks**

The effectiveness of the rural telecom incubator could be considerably enhanced by leveraging two kinds of networks to increase rural and technology access. Figure 3 indicates the linkages between the proposed rural telecom incubator and other institutions in the innovation ecosystem.

**Insert figure 3 about here**

**Tiered rural network:** One of the challenges of fostering rural telecom entrepreneurship is that of identifying and stimulating interest among potential entrepreneurs. Entrepreneurial individuals who understand both telecom technology and rural needs, and are interested in launching new rural telecom ventures, are probably thinly spread out across India. They may be best reached through second tier technology institutes located close to rural areas. The reach of the rural telecom incubator can thus be extended by developing linkages with second-tier technological institutes to create a network through which information and expertise relating to technology and market opportunities can be exchanged.

**Telecom technology network** One of the challenges for a rural telecom incubator would be access to cutting-edge technology research. An incubator within the context of a higher education system could work well as the role of university linkages is critical for incubation in the knowledge-intensive domain (Mian, 1996). Apart from providing necessary infrastructure support for nurturing firms, universities provide networking opportunities within the ecosystem, which are essential for success (Freel, 2003; Hansen et al., 2000; Johannisson, 1988; Tse, 2002; Rothschild and Darr, 2005). Since development of products and services in the telecom sector requires in-depth knowledge of standards, protocols and requirements engineering, easy and formal access to the university ecosystem would provide significant benefits to incubatees. Access to cutting-edge faculty research, library, databases and the university's network, including alumni and students, would be a valuable resource.

In this context, the public private partnership (PPP) initiative of the government in setting up Telecom Centres of Excellence (TCOE) is important. These centres have been set up at leading technology and management schools in the country (www.tcoe.in). While some have focused on functional specialization (development of security applications), others have a more generic focus. Some specifically work in rural telecom technology (for example, IITK). Since several TCOEs have their own incubation centres (albeit, not necessarily focused on rural telecom), there are significant benefits that both the incubator and incubatees would derive from the network. Incubatees would benefit in terms of access to existing faculty resources working in the telecom sector, projects in TCOEs focusing on rural telecom, and students and other knowledge resources. The proposed rural telecom incubator would also benefit from learning from the experience of management processes of existing incubators at TCOEs.

**Seed Funding**

The low activity level of venture capitalists and angels in India makes it difficult for entrepreneurs to find capital to launch ventures and scale them. This is especially difficult for rural telecom on account of the perceived risk and, in some cases, the large capital needs. The government could help out by providing funding from the USOF. Other capital sources could be the rural development funds, as telecom services contribute very significantly to economic growth, or regional funds such as those meant

for development of backward or hilly areas, or the North East of India. Typically, government departments and ministries have worked in silos, thus reducing the ability to leverage telecom services for development.

**Market Test**

While institutional conditions necessitate government funding, this creates the risk of suboptimal use of capital since its provision might not undergo as rigorous a vetting process as funds provided by angels and VCs. This makes it necessary for rural telecom incubators to attract angels, VCs and serial entrepreneurs to work with incubatees.

Another way for the incubator to expose entrepreneurs to market tests is to make them interact with groups of experienced players located in other regions, or perhaps, even in other countries as the Swiss Government does by bringing entrepreneurs to Cambridge, USA and getting them to interact with seasoned professionals who may not understand the Swiss environment but are able to force entrepreneurs to examine fundamental issues such as meeting market needs and dealing with challenges of scaling up.

**Companies with Robust Rural Platforms**

Companies such as ITC have set up significant operations in rural India and are open to using their platform to partner with other companies that wish to provide products and services in villages. As successful for-profit ventures, such companies are careful about ensuring that the services provide for adequate contribution margins built into the business model for all parties involved in service delivery. This helps ensure economic feasibility of the business. Start-ups could benefit from engagement with companies like ITC and such affiliation could perhaps be aided by the rural telecom incubator.

## GENERAL MEASURES TO FOSTER RURAL TELECOM INNOVATION

Besides the specific issues related to supporting telecom entrepreneurship in India, there are challenges in general areas of business, and legal and operational aspects of entrepreneurship, that the government could help address.

**Enhancing ease of doing business**

India ranks 133 in the World Bank's "ease of doing business" rankings; China and US are ranked number 3 and 4 respectively (World Bank, 2010). The time and costs involved in registering and opening new enterprises is high in India. Extensive paperwork presents unnecessary hurdles leading to loss of valuable time. Special fast track processes could help in lowering the time and cost of setting up new rural telecom ventures.

**Entrepreneur-friendlier bankruptcy laws**

A significant percentage of start-ups fail. The social, psychological and opportunity costs of failure are compounded by economic costs. High risk and unclear returns make potential entrepreneurs shy away from starting new ventures. This deterrent can be eased with appropriate bankruptcy laws that reduce the risk of ruination and provide entrepreneurs with hope that they will be able to rebound from failure.

**Encouraging business and technology graduates**

By modifying their policies educational institutes could motivate graduating students toward incubation and entrepreneurship; for example, deferred placement for students opting for incubation or choosing entrepreneurship as their specialization. In the specific case of the proposed rural telecom incubator, this would mean targeting such advocacy towards technology and management institutes.

## CONCLUSIONS

The paper has highlighted the specific context of rural telecom services and why innovation, incubation and entrepreneurship are critical to the development of innovative services for such areas.

Penetration of rural services requires innovation in both technology and business models. Some of the technological innovations specific to rural areas must address the low availability of power, provision of low cost handsets, visual and audio interfaces, multi language support for applications. Business model innovation would be driven by the low ability to pay, low literacy levels etc. Incubation Centres that support rural innovations for the rural market could address the availability of relevant technologies and solutions for the rural market. Such an incubator should have strong linkages with

well established technology institutes, incubators and test beds on one hand and with institutions that are close to rural markets on the other. To begin with, public funding both through existing USOF and other funds meant for socio-economic development of rural areas should be used to support to support such incubation centre/s. Over time, private funding, VCs could come in. With appropriate governance and management structures, such a centre could have more market based perspective, even in the early stages when it is publicly funded.

**Table 1**

**Categories of Interviewees**

| | **India** | **US** | **Total** |
|---|---|---|---|
| Officials supporting incubation | 13 | 2 | 15 |
| Entrepreneurs | 10 | 4 | 14 |
| Angels | 0 | 2 | 2 |
| Total | 23 | 8 | 31 |

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## Appendix 1:

*(Extracted from the official websites of respective institutions)*

**IIT Delhi, India** *(http://www.fitt-iitd.org/about/index.html)*

"Foundation for Innovation and Technology Transfer (FITT) was established at the Indian Institute of Technology Delhi (IIT Delhi) as a Registered Society on the 9th July 1992. The mission of FITT is to be an effective Interface with the Industry to foster, promote and sustain commercialization of Science and technology in the institute for mutual benefits. The primary objective of FITT is to market the intellectual ware of IIT to industry on competitive terms and at the same time inject industrial relevance to IIT's teaching and research activities".

**Rural Technology Business Incubator, IIT Chennai, India**
*(http://www.rtbi.in/about.html)*

"RTBI has emerged from IIT's informal incubator - The TeNet Group - known to be at the forefront of innovations in Information and Communication Technology (ICT) for the developing world for the past twenty years. The TeNeT Group comprises of faculty members from the Department of Electrical Engineering, and the Department of Computer Science at IIT Madras, who have conceived RTBI as a way to focus on the developmental needs of rural India. The Incubator provides its Startups and future ventures with easy access to labs, conference rooms, and administrative facilities for ease of function as well as provide a convivial and professional atmosphere for business development".

**Society for Innovation and Development, IISc Bangalore, India**
*(http://sid.iisc.ernet.in/)*

"The mission of SID is to enable India's innovations in science and technology by creating a purposeful and effective channel to help and assist industries and business establishments to compete and prosper in the face of global competition, turbulent market conditions and fast moving technologies. SID strives to bring the leading

intellectuals of IISc and the fruits of their research and development efforts closer to industries and business establishments in a cordial atmosphere with prosperity of the Nation as the ultimate goal. SID is a society registered under the Karnataka Societies Act, with a symbiotic relationship with IISc. It primarily draws from and provides access to the intellectual and infrastructural resources of IISc".

**ICICI Knowledge Park, Hyderabad, India**
*(http://www.iciciknowledgepark.com/icicikp/index.asp)*

"IKP Knowledge Park is a not-for-profit company under Section 25 of the Companies Act 1956. IKP Knowledge Park (IKP) nestles in a 200-acre pollution free zone in Genome Valley, Hyderabad. The master plan of the Park mirrors its objective of nurturing an environment for innovation and the expected growth in life sciences and related fields. It has a mix of ready-to-use multi-tenanted modular wet laboratory blocks (Innovation Corridors) with in-built flexibility around some common, shared facilities and support services, as well as developed land for customized R&D facilities".

**Centre for Innovation, Incubation and Entrepreneurship, IIIT Hyderabad, India** *(http://www.iiit.ac.in/research/centers)*

"The center encourages creative, strategic and transformational thinking, with stress on ideas that are niche unique & differentiable and also on products that have direct social and industrial impact.

The center conducts background research and trains students to identify innovation & technology intervention opportunities, market impact & sustainability and emerging technologies and local penetration. It helps entrepreneurs take the first steps in bringing their business idea or product to life by introducing product development process, incubation space & support, transfer of technology from research labs, legal counseling and networking with industry."

**Cambridge Innovation Centre, USA** *(http://www.cictr.com/#/about/)*

"Overlooking the Charles River and the MIT campus, and literally across the street from the MBTA Red Line station in Kendall Square, Cambridge Innovation Center is the area's largest and most popular flexible office space facility for small and growing\\

companies.

CIC's spaces and services are designed to meet the needs of today's technology-oriented companies. Our clients, many starting at CIC when they were just a few people, has raised over $865m in venture capital since we started keeping track in 2001".

**TCS Co-Innovation Network, India**

*(http://www.tcs.com/about/tcs_difference/innovation/network/Pages/default.aspx)*

"TCS' Co-Innovation Network (COIN™) is a diverse network that brings value to customers from the entire technology landscape. As opposed to the rigid engagement models of the past, COIN™ uses IP management and partnering strategies to drive innovation in an environment of open communities and solution brokers. Solutions also involve technologies wrapped in process bundles, and new software investments based on subscription rather than ownership".

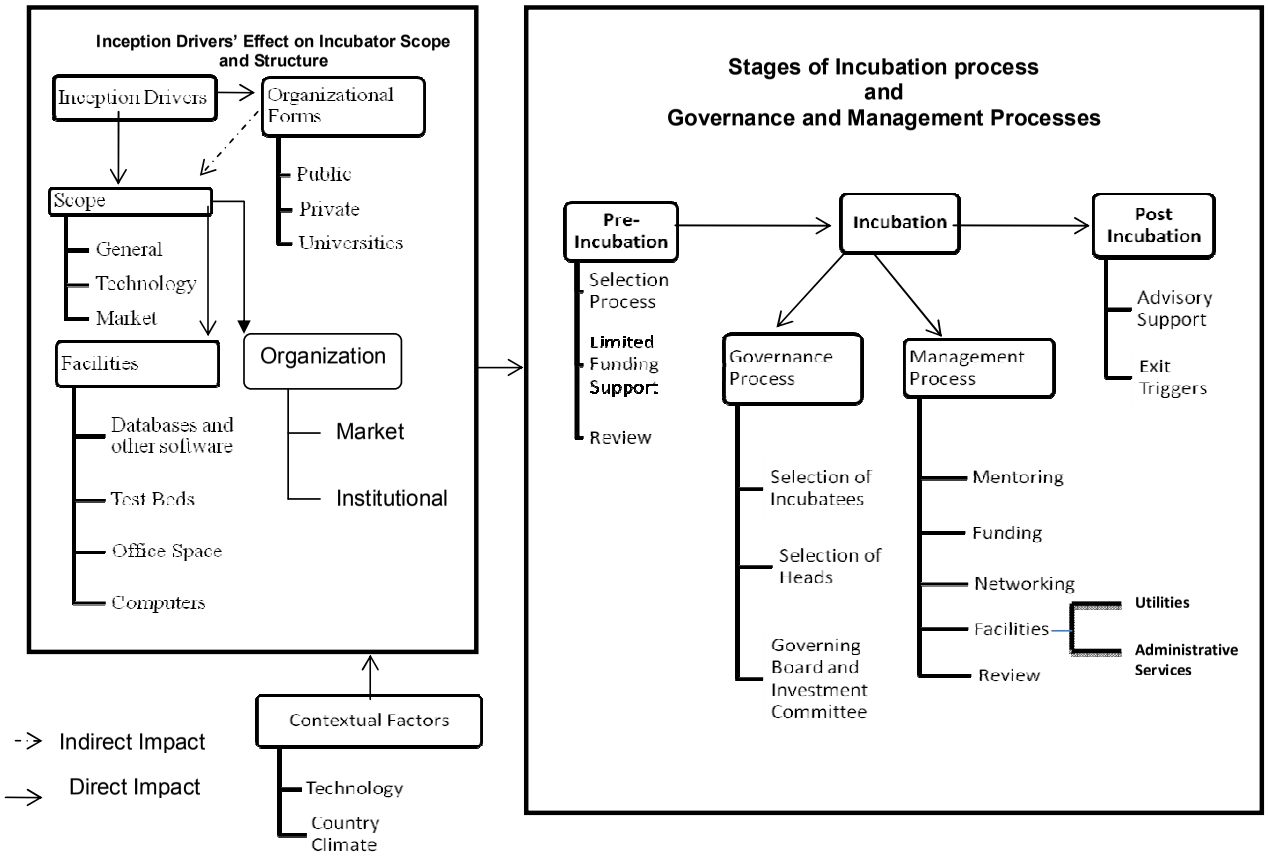


**Figure 1: Framework for the Incubation Process**

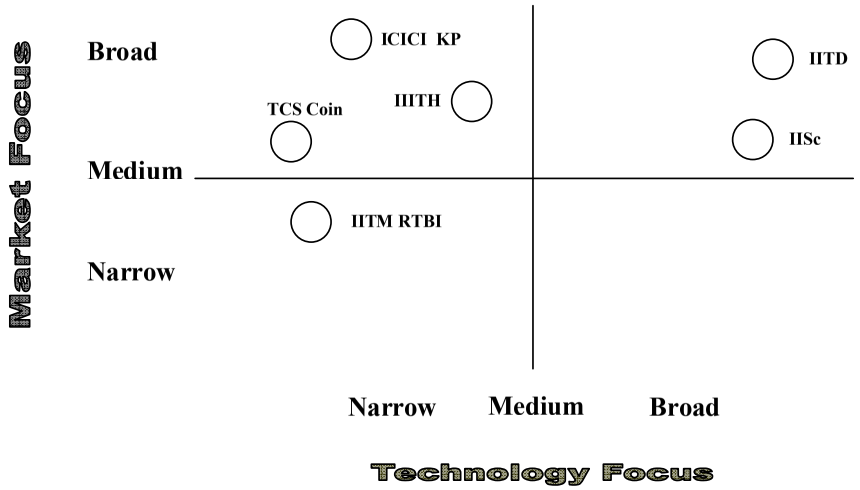


**Figure 2: Types of incubators**

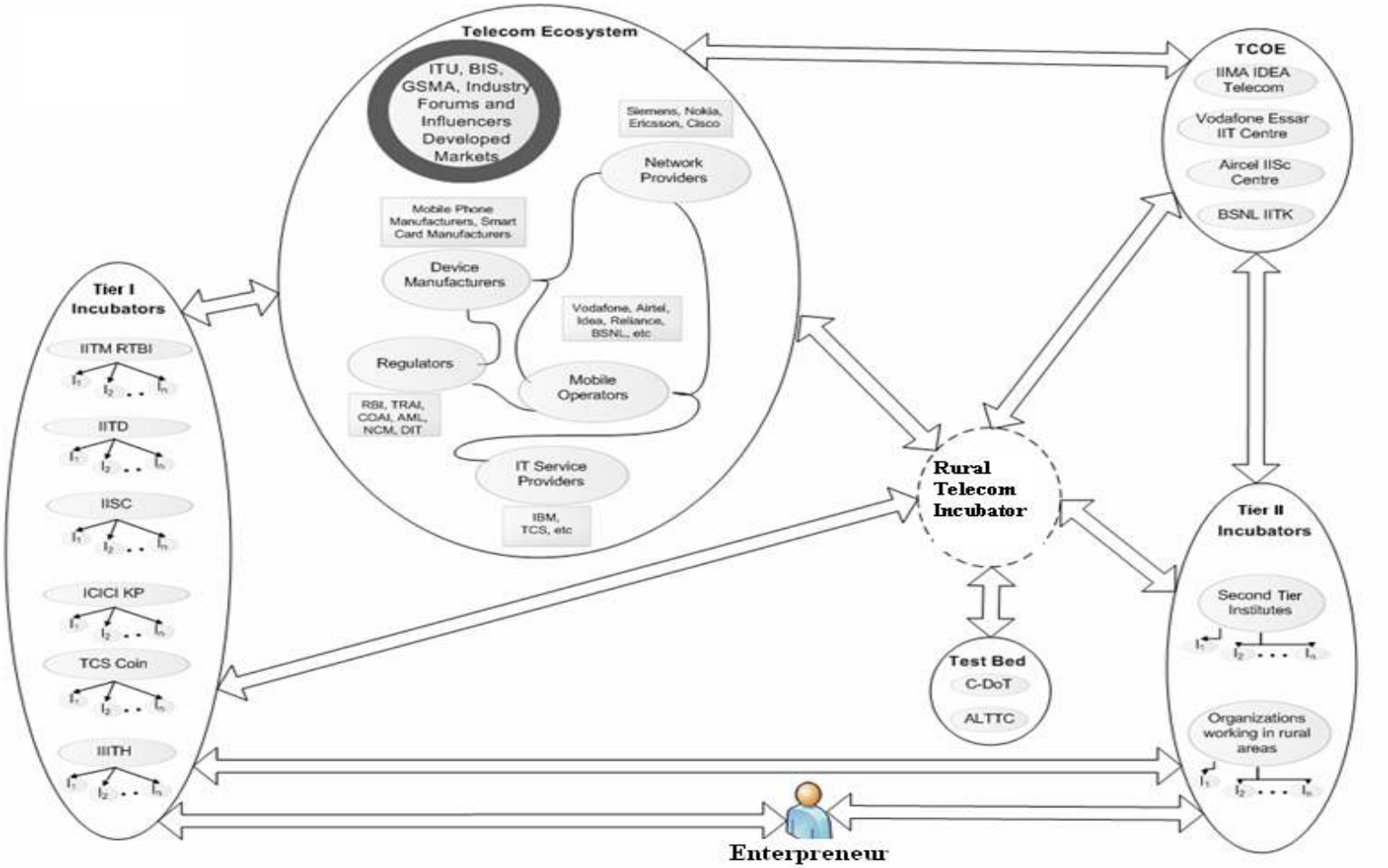


**Figure 3: Proposed Rural Telecom Incubator Model**