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ICTs and Access to Knowledge in Rural India

A comparative study of two models of deployment

Ramesh Subramanian

Introduction: India's disparate development

India's economy passed the US\$1 trillion mark in 2008 (*The Economist* 2008a). It is one of the few countries experiencing economic growth despite the current global economic downturn. From 2003 to 2008, India's GDP registered a 9 per cent average annual growth (*The Economist* 2008b). This growth rate diminished to about 7 per cent during 2008–10, but many analysts predict that India's growth is likely to continue into the future with an average annual rate of 6.3 per cent from 2008 to 2030 (*The Economist* 2008b). Much of India's growth has been led by the service and industrial sectors, which have grown at 10.7 per cent and 9.4 per cent, respectively, in 2008 and 2009 according to India's Finance Minister P. Chidambaram, as stated in his 2008–9 union budget address (Chidambaram 2008).¹ India's IT sector has contributed heavily to the country's growth story. The IT industry provides direct and indirect employment to approximately 5 million people, according to NASSCOM, India's software industry trade association (NASSCOM 2008). Today, the results of more than ten years of sustained growth are becoming visible. Indian cities bustle with commerce, and middle-class Indians are experiencing rising wages in all sectors. The wage increases have generally occurred in urban areas, especially in the IT and services industries. With rapid income growth, the vast Indian middle class (numbering approximately 400 million) is becoming one of the fastest, and largest growing consumer societies and marketplace coveted by much of the developed world's marketers. Indian cities are experiencing a construction boom with new Western-style skyscrapers, shopping malls, entertainment complexes and upscale restaurants – all thronging with eager shoppers and patrons. The mobile telephone is ubiquitous even among the lowest of wage earners. In fact, as Edward Luce points out, there is an air of optimism and confidence in today's India that did not exist even a decade ago (Luce 2007).

Yet despite these developments, India still lags far behind in the sphere of human development. India's population, which is around 1.2 billion, is expected

to surpass China's by the year 2030. The 2007–8 Human Development Report (HDR) published by the United Nations Development Program (UNDP) gives India a Human Development Index (HDI) score of 0.619, which places it in the 128th position among 177 countries. The adult literacy rate of India in 2005 (as reported in (UNDP, 2007) 2007–8) was 61 per cent, behind countries like Namibia, Morocco and Equatorial Guinea. It is clear that the physical and social infrastructure required for enabling a higher quality of living and development has not kept pace with the country's economic growth. While cities and urban areas have benefited from the economic growth, vast tracts of rural India are still largely underdeveloped and untouched by technological developments in urban areas. More than 700 million Indians live in rural areas and far-flung villages that do not yet have basic services such as electricity, sanitation and water, much less knowledge-enhancing technologies such as telecommunication services.

The importance of access to knowledge (A2K) as a measure of human development has been clearly stated by many development experts. The UNDP's HDR of 2006 lists three essential elements for human development: long and healthy life, knowledge and a decent standard of living (UNDP 2006). A 'knowledge economy' is increasingly being seen as indispensable to development. For the fruits of India's economic growth to truly reach a majority of its people, A2K is critical.

India's low HDI rating has led many in India publicly to express concern that the much trumpeted growth story of the past seventeen years has not permeated to much of Indian society, a majority of which (approximately two-thirds of the population) lives in rural areas untouched by developments in urban areas. In fact, approximately 70 per cent of the entire Indian workforce is engaged in some form of agricultural endeavour, far removed from the development and technologies that are visible in urban India. Many in India have argued in recent times that unless technological developments that have enriched urban India are made accessible to those in rural India, wide disparities in income and quality of life would escalate, making the current growth unsustainable, which would, at worst, result in unrest and chaos.

Many reasons could be given to explain the lack of knowledge-enhancing technologies in rural India. One important reason is the prohibitive cost of connecting India's vast rural areas with telecommunications. A second is the non-availability of appropriate, cost-effective technologies that work in remote rural areas that experience extreme weather and environmental conditions. Telecommunications technologies faltered during the first four decades after India's independence from British rule. The socialist model adopted by the government emphasized Soviet-style central planning. Self-sufficiency was the over-abiding 'mantra' propagated by the government. Large public-sector monopolies were created, with little incentive to innovate and adopt new technologies. Newer technologies, especially those emanating from abroad, were strictly controlled through very restrictive licencing systems that dissuaded the private sector from

entering areas such as telecommunications. Capitalism was widely viewed as a 'sin' by the government policy makers. Telecommunications was considered a luxury and thus not considered critical for development. The government viewed energy, manufacturing, nuclear technology and so on as more important for development. Research and development in the govern-run telecommunications sector was non-existent. As late as the year 2000, India's rural teledensity (number of telephone lines per 100 people) was only 0.68 (Subramanian 2008). The third, and perhaps the most important, reason for the urban-rural disparity pertains to the social and cultural milieu that is more apparent in rural India and less so in urban centres. India has been for long a class-based society, where class was strictly determined by which caste one was born into. The caste system was legally abolished in 1950 by the Constitution of India and has generally disappeared in urban India. However, it still persists in rural India. Often, people belonging to one caste are not welcome in establishments run by members of another caste, which causes serious impediments to the notion of equal access to education, technology and knowledge, among other things.

Information and communications technologies (ICT) for development: policies and projects take root

By 1984, Indian policy makers had begun to accept the stark reality – that four decades of 'planned' growth and a socialistic outlook that engendered restrictive business and industrial policies had failed India and had not caused any appreciable positive change in the people's living conditions. A persistent disparity continued to exist between urban and rural India. The policy makers were finally forced to undertake radical economic reforms, starting in 1984, due to a worsening debt crunch and balance of payment situation. India came under strong pressure from international lending agencies to restructure its economy. This finally forced successive Indian governments towards liberalizing the Indian economy. Since 1984, developmental efforts have gained much stronger focus, coinciding with the gradual liberalization of India's economy coupled with the above-mentioned growth of India's IT sector. Today there is increasing emphasis on narrowing the 'digital divide' by bringing IT developments, especially telecommunications and the Internet, to rural areas. ICTs are considered the vehicles for bringing economic development to rural India.

Currently the issue of rural development through telecommunications is being addressed at several levels: the governmental, non-governmental (through NGOs), private-enterprise and scientific/research levels (at academic and research institutions). New telecommunications policies that more clearly reflect the new economic, political and technological realities emerged during the last decade of the twentieth century. These were announced in 1994 as the

‘National Telecom Policy’ and fine-tuned in 1999. One of the objectives of the new National Telecom Policy of 1999 was the provision of universal service to all uncovered areas, including rural areas (Subramanian 2008).

The new policies have opened up the telecommunications arena to private enterprises, and this has led to the development of greater telecommunications infrastructure in the country. At the end of 2007, India’s rural teledensity stood at 7 (Kaushal 2007). This figure, while still much lower than other countries such as China, still denotes a significant improvement of rural teledensity figure of 0.68 over the year 2000. In the meanwhile, aided by improved licencing policies, mobile telecommunications have taken a quantum leap. In June 2009 alone, India added 11.9 million new wireless subscribers, taking the total subscription base to 464.82 million (*The Economic Times* 2009).

Today, several ‘A2K’ projects are underway in rural India. The projects are varied in nature. Some are sponsored by governmental agencies while others are run by NGOs. Some of them focus on the technological aspects, that is improvements to telecommunications and Internet technologies to bring information technology to rural India (i.e. the hardware), whereas others focus on the accessibility and informational aspects (i.e. form and content). The projects also use different approaches or models, with some focusing on sustainability through social entrepreneurship, some on a ‘corporate’ model that is aimed at providing channels and easier access to farmers to the markets, and others focusing purely on community development through information dissemination, without specific business models. The last model mentioned aims to uplift and enhance rural communities with the aim of making them more knowledge-aware, to eventually enable them to become sustainable communities. Many of these projects have been studied, or are currently being studied, by researchers. However, as noted (in *The Economist* 2005), the biggest problem in A2K and ICT4D projects is that it is very difficult to determine the real usefulness of these projects, especially with regard to rural development. In fact, there seems to be no effective data collection methodology for studying the efficacy of these projects. In such a situation, it would be best, as suggested by the *Economist* article, to simply ask the villagers themselves on how useful they see these attempts to be – that is a qualitative approach.

Objectives

The main objectives of this chapter are

- to study and analyse two types of rural ICT4D projects in southern India focusing specifically on the rural knowledge creation, management and dissemination aspects; and

- to report the results of a field study comparing the two models and factors that influence the success or failure of the two types of projects.

I hope that this study will provide critical information on current knowledge-based development efforts in rural India – where they have succeeded and where they have not. The lessons from this exercise will be of great value to policy makers, NGOs and researchers in identifying and designing more effective programs and plans for rural connectivity and ‘A2K’ schemes.

Methodology

This is a combination of a qualitative study and one based on a survey of prior work in the area. I conducted literature reviews and analysed the advances and adaptations that have been made to wireless Internetworking technology in the Indian context. I identified key scientists and project associates, especially in Tamil Nadu, who are currently involved in various rural connectivity projects. I interviewed them in India with a view to learning more about the pilot projects and implementation details. I also visited many of the rural areas where Internetworking projects are underway and qualitatively studied the nature and uses of the applications, along with some specific economical and social indicators that can be correlated to the use of Internetworking technology. This was done using a combination of long interviews and published data. I conducted long interviews of rural women in order to learn and understand more about their views of democratization as well as their views on the emerging role of rural women in commerce, entrepreneurship and technology. (A ‘long interview’ is ‘a sharply focused, rapid, highly intensive interview process that seeks to diminish the indeterminacy and redundancy that attends more unstructured research processes. The long interview calls for special kinds of preparation and structure, including the use of an open-ended questionnaire, so that the investigator can maximize the value of the time spent with the respondent’ (McCracken 1998). According to McCracken, the long interview process enables the researcher to delve deep into the mind of the subject and learn more about the world as it is perceived by him or her. This type of data collection method also provides a subject’s critical interpretation of an event or development as experienced by him or her.)

Prior work

Subramanian and Arivanandan (2009) listed a number of studies of the application of ICT in rural areas by government, NGOs and academic and

non-academic institutions. I have listed them here. Hollifield and Donnermeyer studied factors that influenced individual-level adoption of new communication technology among the residents of four rural Midwest communities in the United States (Hollifield & Donnermeyer 2003). They examined demographic, community and employment influences on the adoption of Internet technology and use of email. Their study revealed that more than 50 per cent of the respondents used email and 60 per cent used the world wide web. The study also revealed that adoption of new technology was influenced by age, gender, economic and education variables. The study also suggested that demand for information technology would increase if locally owned businesses were encouraged to adopt technology. Finally, the study concluded that policy makers and rural development experts need to recognize the complexity of rural social networks and the advantages of using multiple starting points to encourage the diffusion of new information technology. The findings of Hollifield and Donnermeyer parallel those of Srinivasan (2004), who identified factors like language, workload, caste and geographical location of the people and their correlation to technology adoption and use in rural India. Cecchini and Scott (2003) described various issues with ICT projects in rural India, such as the cost of information infrastructure, inadequate or absent connectivity, unstable power supply, the role of small entrepreneurs in sustainability of ICT in rural areas, the accessibility of ICT by rural women and poor, disparities between gender and the caste of the ICT operators and trainers.

A UNDP case study undertaken by Gurumurthy, Singh and Kasinathan (2005) concerning TeNeT,² n-Logue³ and Development of Humane Action (DHAN) Foundation⁴ explored the appropriate ownership models for rural pro-poor ICT initiatives in the Melur area near Madurai in Tamil Nadu. They felt that the community-based model, which focused on providing community service through ICT, is more effective in the rural areas than other business models (such as the social entrepreneurship model promoted by TeNeT).

T. T. Sreekumar in his study of the Gyandoot ICT project (Dhar district of Madhya Pradesh) and TARAhaat kiosks project (Madhya Pradesh) highlighted the role of gender in rural ICT projects. He states,

In the Indian context, the analysis of the patterns of inclusion in rural cyber kiosks shows that non-participation, particularly by women, is an important drawback in ICT-based projects. Contrary to popular belief, these social enterprises are not inclusive enough, and the social factors that perpetuate inequalities in rural areas are in fact reinforced by the projects rather than eliminated. The participation of women and the underprivileged in these projects is abysmally low and this is strikingly in contrast to the projected image of these initiatives as being overly sensitive to issues of gender and social divisions. (Sreekumar 2007)

The TARAhaat-established kiosks were found to be overly dependent on the support of the local elite class. These elite people controlled the social milieu in the domain of activities often offered by the kiosk. Sreekumar suggests that in

order for the tele-centres to function in this environment they invariably have to accept the traditional social divides, including the gender divide, instead of striving to transform them.

The literature reveals certain recurring themes, such as the influence of social liabilities such as class, caste, economic background, education, geographic location and so on, *in addition to* the availability and accessibility (or lack thereof) of the technology itself. The problem of sustainability of rural kiosks is also discussed by some researchers. Not surprisingly, reports emanating from *internal* project personnel take the view that these projects are very successful – which conflict with other research results by *outside* researchers. Notable among the ‘doubters’ is Kentaro Toyama, who has researched on this topic and has published results that show that there are numerous reasons why rural kiosks in India might fail (Toyama 2005; Toyama *et al.* 2005). These reasons include extreme poverty, lack of perceived value and appropriateness of cost of operations.

This study seeks to build upon existing research but provides a different perspective – a comparative analysis of two ICT4D or A2K models. I focus on two such ongoing projects at a micro-level, focusing on specific projects and individuals in the affected communities. They are the Village Knowledge Centres (VKCs) project initiated by the M. S. Swaminathan Research Foundation (MSSRF), Chennai, India, and the Indian Institute of Technology Madras’s (IITM) TeNeT-based ICT4D projects.

The following were the primary research questions for this project:

- 1 What are the differing *business models* adopted by these two types of projects?
- 2 What *technologies* are used in these projects? What are the differing architectures used?
- 3 What, if any, are the different Internetworking applications and prototypes currently deployed?
- 4 What are the educational, social and economic consequences of these projects in the communities they are deployed?
- 5 Is any one model more successful? If so, what factors can be attributed to project success?
- 6 What are the impediments to success of rural development projects?

In what follows, I focus on these questions with respect to the two projects under the following themes: (1) genesis of the projects; (2) implementation of the projects (including technologies used for telecommunication, knowledge collection and storage, and knowledge dissemination); (3) data and evidence collected during field visits; (4) analysis of the two projects, including a

discussion of how this study maps into the A2K Index proposed by Lea Shaver (2007) and (5) conclusions on the effects and consequences of rural ICT vis-à-vis A2K and development.

Project 1: MSSRF'S VKCs

MSSRF is a non-profit organization founded by the noted Indian food and agricultural scientist, Dr M. S. Swaminathan. The foundation was registered in 1988 to research, advance and promote coastal systems, biotechnology, biodiversity, eco technology, food security and information, education and communication in developing countries, with a specific focus on India. In 1998, the foundation started the 'VKC' project. The idea was to select villages in rural Tamil Nadu and the Union Territory of Pondicherry (both in southern India) and provide adequate telecommunications infrastructure that would enable the dissemination of appropriate information regarding farming, education, health, weather, governmental news, job, loans and aid opportunities. The objectives were to reduce the digital gap and gender divide in rural India using technology – especially telecommunications technology. Each VKC would serve one or more villages and would act as the knowledge repository for the villages it served.

Pertinent information was stored in databases in these sites, with appropriate technology for easy access and dissemination of this knowledge to persons seeking them. The long-term objective was eventually to set up VKCs in each of the approximately 638,000 villages in India, thus creating a nationwide rural knowledge repository.

The three-tier hub and spokes model

The MSSRF's VKC project uses a three-tier hub and spokes model. The highest tier (i.e. Tier 1) is the state-level hub at the MSSRF headquarters in Chennai, India. The informatics centre at the state-level hub is connected by Internet Service Providers (ISPs) and the Indian Space Research Organization's (ISRO) uplink satellite through a Very Small Aperture Terminal (VSAT) antenna to universities, scientific institutions, governmental agencies and other panels of experts. Information from these external sources are collected, collated and transmitted using the VSAT connection to the next tier, Tier two.

Tier 2 is the Village Resource Centre (VRC). Each VRC serves as a hub, typically connected to twenty to thirty VKCs spread over a 60-km radius. The VRC is designed to act as a rural library and technology resource centre. Each VRC consists of at least three networked computers, one scanner, two web cameras, Internet access, one printer, one digital camera, solar backup facility

and training rooms. Each VRC is also connected to other VRCs and the MSSRF headquarters in Chennai through satellite link-ups, in collaboration with the Indian Space Research Organization (ISRO). The ISRO–MSSRF network uses one of the extended C-band transponders of ISRO’s satellite INSAT-3A. Users at each VRC and at the headquarters in Chennai can communicate through video and audio links provided by the satellite connection (ISRO 2004). The VRCs at various rural locations are connected to the Tier 1 state-level informatics centre hub (and ISRO satellite) through VSAT. Internet connectivity to the various VRCs is achieved through the ISRO–MSSRF network.

The VRCs in turn provide network connectivity to the VKCs, which serve a particular village. The VKCs form Tier 3 of the MSSRF architecture. Each VRC is connected to the VKCs and other VRCs using Motorola very high frequency (VHF) radios for voice and data transmission. However, in actual practice, it was noted that this technology posed restrictions on transmission speeds as well as the size of the files transmitted. As a result, starting in 2001, spread spectrum wireless technology was introduced for VRC–VKC and VKC–VKC communications (Senthilkumaran & Arunachalam 2002). The VKCs are usually equipped with desktop computers, printer, radio communications equipment, wireless tower antenna, a video kiosk and applications such as desktop publishing. The applications vary from VKC to VKC, depending upon specific need.

Genesis of the MSSRF’s VKC project

The VKC project was started at Villianur, a village in Pondicherry. This location was chosen because of MSSRF’s experience and knowledge of the village, which also was the centre for its ‘bio-village’ project. The bio-village project was started in 1991. Its mission was to provide the above-mentioned service with a specific ‘pro-poor, pro-women and pro-nature’ foci. The VKC project is purely developmental in nature. The cost of setting up a VKC is Rs 200,000 (US\$4,500) approximately. This cost is completely borne by MSSRF, which in turn receives aid from international aid agencies such as the International Development Research Center (IDRC), Canada, and Japanese aid agencies for implementing the project.

Typically, MSSRF field officers identify a village to set up a VKC. They identify and train project associates and create a core group of associates who then canvass the idea of setting up a VKC with village leaders, politicians and land owners. Public meetings are held to ‘sell’ the benefits of VKCs to the villagers. Here, the role of women’s ‘self-help groups’ (SHGs) is invaluable. Women’s SHGs were initiated by NGOs in India. The first SHG was started in 1985 by Mysore Resettlement and Development Agency (MYRADA), an NGO located in Mysore in the State of Karnataka (Fernandez 2007).

In 1990, the state government-run Tamil Nadu Women’s Development Corporation started implementing an NGO-supported project to empower

women in the state. The women's SHGs purport to help socially and economically disadvantaged women by providing them with training, micro-loans and ways to organize in small groups. Each SHG consists of about fifteen women in a village. Women belonging to these SHGs are the first point of contact to MSSRF field officers, and help the field officers in gaining a familiarity and foothold in the villages.

Once the initial contact is made, and the idea of the VKC is 'sold', MSSRF sets certain conditions that are required to be met by the village in question:

- The village must provide a room that is open to and accessible by all members of the community. This condition is very important because, as noted earlier, India's villages are still mired in the class and caste system, which inhibits certain castes and classes from using such centres.
- The village must also pay for the cost of electricity and telephone connection to the VKC.

Once the villagers agree to the idea and the conditions, MSSRF sets up the VKC. A local individual is identified and selected to be the VKC's volunteer operator. This individual, mostly a woman from the village with at least high school education (even though there have been some exceptions to this rule based on an individual's ability), is then trained by MSSRF on basic computer operations and applications. The volunteer is given training in O/S, MS Office Suite, Adobe PageMaker and Photoshop, Visual Basic, Visual C++, HTML, voice recording, Zip and Unzip utilities and voice and data transmission in a wireless infrastructure. The selected person also receives a small honorarium of Rs 1,200 (approximately US\$28) per month.

Technology and operations in a typical VKC

Each VKC has one or more desktop computers, at least one printer, radio communications equipment, a wireless tower antenna mounted on top of the building and, in some cases, a video kiosk. These are maintained by the villagers. According to Senthilkumaran and Arunachalam (2002), the villagers fully understand the importance of the VKC – 'Even in times of clashes between different groups (common in Indian villages), the VKC and its equipment are not damaged.'

The videos enable visitors to play and watch video-tutorials on farming, health and other topics. The computers have Microsoft Office, Net Meeting, games, publishing software, databases containing information pertaining to health, education, agriculture, commodity prices, government job vacancies and so on. The information in the databases is updated at regular intervals (sometimes daily) by downloading the updates from the VRC servicing the VKC. Each VKC also has a public address system using which the VKC

volunteer is quickly able to disseminate critical and useful information to the homes in the village. In addition, each VRC and VKC has complete training videos and CDs for the Microsoft Unlimited Potential Program (MUPP). This is a program from Microsoft to 'provide nonprofit organizations with funding to support technology training programs ranging from learning basic computer skills to using advanced business productivity applications (Microsoft Corporation 2008).'

Each VKC selects and helps promising youth to undergo various types of computer skills training. The training sessions are held at the appropriate VRC. Additional online, video and CD-based training materials and exam practice materials are available for use by the trainees at the local villages through the VKCs.

Technology and operations at a VRC

As noted above, the VRC forms the hub of activities for a cluster of VKCs. Local project staff maintain the systems at the hub. The wireless system and web server administration are taken care of by the Informatics Centre of MSSRF in Chennai. The VRC creates and maintains numerous databases pertaining to agriculture, commodity prices, livestock health and welfare, medical data, governmental data, grants and aid availability from various agencies of the government, women's welfare-related data and so on. Each VRC has a fully equipped library containing magazines and other publications in local languages. The VRC also develops and maintains web portals in Tamil, the local language, to disseminate information on the above-mentioned issues. Each VRC also uses DTP tools to publish a Tamil-language newspaper *Namma Oor Seidhi*, which translates to 'Our Town's News'. This paper contains news and events of interest to villages served by the VRC. As can be seen, a key aspect of the VRC concerns the creation and updating of relevant content to suit local needs. The VRC plays the role of a 'value addition centre'. The VRC at Villianur (which has subsequently been relocated to Pillayarkuppam) has generated around one hundred databases to fulfil the specific information needs of the local communities. Most databases are updated on a daily basis. A considerable amount of information is accessed from local sources. Many of the databases are in multimedia form for the benefit of illiterate people (Senthilkumaran & Arunachalam 2002).

Field visits and observations

I undertook several field trips to observe the actual operations of the VRCs and VKCs. The interviews and field trips took place between August 2007 and February 2008. I interviewed villagers (including school-going children), technicians associated with the centres, the kiosk owners and VKC volunteers.

The MSSRF's VRCs and VKCs that I visited are located in the Union Territory of Pondicherry, located about 100 km south of Chennai, a major metropolis in southern India. Pondicherry is generally more developed than Tamil Nadu, the state that lies adjacent to it. The literacy rate in urban areas is 82 per cent, whereas the literacy rate in rural areas is 54 per cent. The villages that I visited were all within one hour's bus journey from the city of Pondicherry (the capital city of the Union Territory of Pondicherry). However, I observed that the transformation from an urban to a rural setting occurs quite drastically. Within a few miles outside of the city, the land is covered with farmlands and villages where many of the city services (i.e. indoor plumbing, reliable water supply, reliable supply of electricity, public sanitation etc.) are significantly less prevalent. The following paragraphs summarize my observations at one VRC and VKC that were the most representative of the VRCs and VKCs that I visited.

Pillayarkuppam

Pillayarkuppam is a village of about 4,500 people located about forty-five minutes from Pondicherry by road. The VRC at Pillayarkuppam consists of a modern building complex equipped with a VSAT antenna, computers, printers, battery packs, training rooms and even a small radio station. The VRC's VSAT antenna dish rises prominently from the surrounding farmlands. The coordinator of the Pillayarkuppam is a retired veterinary doctor, Dr A. K. Thiagarajan. Dr Thiagarajan explained that the MSSRF's VKC project originated from an earlier, 'bio-village' project, started in the village of Villianur in 1991. MSSRF noticed a preponderance of local traditional knowledge which it wanted to collect, store and disseminate to the local population. This led to the birth of a VKC. MSSRF project officers insist on the term 'VKC' rather than 'information kiosk' or 'Internet kiosk'. During interview, Dr Thiagarajan explained that MSSRF's founder, Dr M. S. Swaminathan, felt that the term 'kiosk' implied a commerce-oriented business centre, which is very different from the purely community development philosophy of MSSRF projects. Dr Swaminathan did not want the VKCs to be just a commercial enterprise, but he wanted to bring in the idea of a shared 'commons' – which is perhaps a leftover from the ideals of socialism engendered by India's first prime minister, Jawaharlal Nehru. Dr Thiagarajan also repeated the claim that MSSRF's projects were aimed towards being 'pro-poor, pro-women and pro-nature'. Villianur was soon connected to several VKCs and became a hub or VRC. In 2005, the VRC was shifted to a more spacious location at another nearby village, Pillayarkuppam. In the following sections, I describe my observations of a VRC and a VKC.

The VRC houses spacious and clean administrative offices with three computers, a scanner, books, magazines and newspapers. The training rooms contain computers, multimedia and projection equipment. There is a computer lab that consists of several computers and appropriate software applications.

I observed a group of women working on editing the VRC's information website and using publishing software to publish the VRC's newspaper.

The Pillayarkuppam VRC controls fourteen villages by being the hub of info-tech services. The VRC disseminates a plethora of information using a combination of wireless (satellite and short wave radio transmission) as well as wired telecommunications infrastructure for connecting to the Internet. The information disseminated includes government employment schemes, commodity prices, information and education on health and hygiene, results of examinations, computer training, women's health issues, government loan schemes (i.e. loans for purchasing motors and other farm equipment) and government-issued certificates (such as birth and marriage certificates).

In addition, the VRC also serves as a resource centre offering training in dairy improvement projects such as clean milk production in association with Ponlait, the milk co-operative that supplies milk to much of the Union Territory. It also publishes the newspaper *Namma Oor Seidhi* for the surrounding villages (ninety-eight in number at the end of 2007). Dr Thiagarajan showed the VRC's library and a bio-lab that collected and categorized native herbs and other flora. The VRC also provided training in animal husbandry and maintained a 'sperm bank' for the artificial insemination of cows. The sperm bank contains numerous temperature-controlled flasks for transporting the sperm to the farms. The VRC imparted training in artificial insemination techniques to local farmers.

The ICT side of the VRC is managed by project associates and technical staff – all recruited and trained from the villages that the VRC serves. One of the project associates working at the VRC is Ms Bhagyalakshmi. She revealed that she had originally worked as a volunteer at another village VKC, located in Kizhur. She had been 'promoted' to her current position because of her interest, enthusiasm and ability to pick up the necessary skills. Prior to her current job, she had been involved with a women's SHG in her village. She also revealed that even though she hailed from a village that did not have any private school, she had moved closer to the VRC's location in order to send her children to a good private school. She was knowledgeable in basic computer skills and was able to train others.

During my visit, I met a group of fifty local farmers who had been brought there for training in livestock care. They were shown audio-visual presentations and lectures by a veterinarian. The audio-visual presentations had been downloaded earlier using the satellite link-up with the Chennai headquarters. I also observed a group of youth attending classes in Microsoft AccessTM (database) software in preparation for taking a Microsoft Certification exam. The training was imparted through a grant from the MUPP. The trainers were either external experts or those trained earlier by MSSRF.⁵

The project associate, Ms Bhagyalakshmi, opined that the whole VRC concept was very empowering to the women in villages, as they not only gained information on various issues related to health and women's issues but also

were often selected to run the VRCs themselves, earning a small honorarium of Rs 1,500. She also noted that women were not given any preference (despite MSSRF's stated policy of being 'pro-poor, pro-nature and pro-women') – either in the access to the VRC or in employment and training opportunities. Despite this, the preponderance of women working in the VRCs led me to believe that the concept of VRC was indeed a vehicle for the enhancement and education of village women.

Embalam

Embalam is a town of 4,000 people, located about forty minutes from Pondicherry. It is served by a VKC, which is connected to the regional VRC at Pillayarkuppam. The VKC is operated by two women, Malathi and Indira Gandhi. Both have completed high school and have completed the Microsoft Unlimited Potential Project training program.

The VKC is located within a small village temple's premises. It is equipped with a computer, printer, a video kiosk and a public address system. The VKC is connected to the VRC by a microwave link. The antenna is located on the roof of the building. The interior of the VKC is very basic and Spartan, in comparison to the much more up-to-date facilities of the Pillayarkuppam VRC. The computer has applications such as Microsoft Office, desktop publishing and e-conferencing software. The VKC downloads current information such as weather updates, coastal tide information, commodity procurement prices, high school examination results and other information pertaining to farmers as well as general and women's and health information from the VRC's databases. Important weather-related information and the arrival of examination results are broadcast to the entire village using the public address system.

The VKC maintained two-way audio-conferencing with the VRC. When a problem occurred with any of the computing, the local associate troubleshooted and then requested pertinent information via the audio-conferencing tool to the VRC if further help was required. During my visit, I observed an e-conference (video conference using Microsoft Net Meeting application software) in progress with another VKC located nearby. Since the power supply in this village was spotty, uninterrupted supply of power was ensured through a bank of batteries.

The project associates informed me that the VKC was mostly used by children and women. Occasionally men used the VKC for preparing and printing letters. (In addition to the honorarium that they receive, the project associates operating the VKC are allowed to charge nominal amounts for services such as preparation of letters, loan applications and printing.) I interviewed school children, who all seemed aware of the VKC and its functions. The village children were very comfortable using the VKC and visited it for checking examination results, for online or CD-based MUPP training, to play computer games, to check the online newspapers and for CD-based science lessons.

Women visited the VKC for health and reproductive health information. The men that I interviewed informed me that some of them used the VKC for information on the weather and commodity prices. It was interesting to note that most of them indicated that much of the information that they needed was available on cell phones, which almost all village farmers possessed. This was an interesting fact and was proof of the prevalence and rapid spread of cellular phones in even rural areas of India.

Overall, the observations led me to conclude that the Embalam VKC is a successful project and had proved its worth to the villagers it served. Through interviews with the various village people, I learned that the VKC was viewed as a symbol of prestige to the village. In fact, its success had prompted the heads of nearby villages to request MSSRF to set up such centres in their villages. The women who worked in the VKC seemed empowered and confident. One of them even had an opportunity to travel to Tunisia for the World Summit on the Information Society (WSIS) in 2005 as a Jamsetji Tata National Virtual Academy (NVA) Fellow. The NVA, set-up in 2003, is endowed by a grant from the Tata Education Trust, a charitable organization, and supports MSSRF's ideals.

Impressions from the MSSRF'S VKC project

The previous sections provide a small but illustrative sample of the many field visits. I visited many more locations and interviewed a variety of people. The samples above provide a very good representation of the MSSRF's VKC project and help provide a window into the facts on the ground as they pertain to the spread and effects of Internet technologies in rural India.

Based on the 'data' obtained through this study, I believe that the effects of the spread of the Internet to rural areas in India has generally been very successful in empowering women and providing them with appropriate information on various health, hygiene and reproductive issues. As seen from the sections above, the training programs offered through the MSSRF's VKC project have enabled women to learn more about computers and the Internet, and has even provided them with meaningful job opportunities as well as opportunities to lead in the areas of education and health. As noted earlier, one of the project associates I interviewed was empowered enough to move her family from her (remote) village to one that was closer to a better school, in order to afford her children with better educational opportunities. All the MSSRF project associates that I interviewed or observed were women. They were confident and knowledgeable about their environment and the world outside their villages. They were leaders in their villages, and would, I believe, be good role models to female children in their villages. The VKCs also provided opportunities for the associates to engage in entrepreneurship, by offering for-payment services such as letter writing, loan preparation and document printing services.

The VRCs, with their bigger and more developed technical infrastructure, seem to offer more services that are relevant to the farmers (i.e. men). The men seemed to take advantage of the training facilities at the VRC level and used the VKCs to get weather reports and market price information. The villagers value the newspaper produced by the VRC and depend on these traditional forms of news dissemination to learn about the news and government-sponsored schemes. During my visit to the Pillayarkuppam VRC, I even observed one villager who had walked several miles in order to enquire about the non-delivery of that month's newspaper. The children who I interviewed in the villages were all very aware of the VKC and appreciated its role as a venue to get online examination results and to learn more about subjects such as computers and science.

Another area that I tried to study was the role that caste played in the success of a VKC in a village. Unfortunately, I could not gain much information that could lead to any definitive conclusions. Most of the associates that I observed and interviewed indicated that caste did not play any role in the functioning of the VKC. However, at a VKC in one village populated predominantly by members of a lower order caste, the project associates mentioned that people from a neighbouring village of higher caste people avoided using the VKC, even though it provided valuable services. This shows the extent to which caste plays a role in the utility of the VKCs – even when it is a clearly perceived utility, certain caste members avoid using a VKC purely because it is located in the 'wrong' village. I plan to investigate the role of caste in attracting or detracting the use of a VKC in a particular village in a future study.

Project 2: The TeNeT group's projects

Genesis of TeNeT's projects

'TeNeT' is the Telecommunications and Computer Networking Group in the Department of Electrical Engineering at IITM. The institute is considered to be among the top technical schools in the world. The TeNeT group's vision is to develop 'world-class technology at an affordable price' (TeNeT group n.d.). The group's researchers focus on addressing the 'pressing needs of India and other developing countries by market-driven product development, strengthening of Indian telecom/networking industry, technical training and education, and driving telecom/IT policy' (TeNeT group n.d.). The group's founder and director is Prof. Ashok Jhunjhunwala, a professor of electrical engineering and pioneer in the field of telecommunications technology and development in developing countries.

Technological innovations at TeNeT

In line with this vision, TeNeT developed a new 'corDECT' wireless local loop (WLL) standard in the late 1990s (Balaji, Gonsalves & Kumar 2002). The corDECT WLL technology is based on the DECT (Digital Enhanced Cordless Telecommunications) standard, which was a technology standard developed in the late 1980s in Europe and published as a standard in 1992 (European Telecommunications Standards Institute (ETSI) 2005). Even in the late 1990s, India's rural telecommunications connectivity was vastly underdeveloped. The teledensity was in the range of 0.68 to 1.5. Even though there was telecommunications connectivity – fibre-optic cable – up to the 'block' or 'district-headquarters' level over much of India, the problem was the lack of connectivity over the last few miles, where 85 per cent of India's villages are located. The lack of infrastructure was attributed to the high cost of laying copper wires over much of rural India. The solution that was promoted by the TeNeT group was the corDECT WLL technology. This technology provides a telephone line and 35/70 kbps Internet connection in a 30-km radius. The WLL exchange and transmission tower can be set up in the town connected to the Bharat Sanchar Nigam Limited (BSNL) network. The prime advantages of this technology were its ability to operate in very warm conditions (up to 55 degrees Celsius), with a low power requirement of 1 kW. The TeNeT group felt that this technology could be used for connecting India's villages, provide appropriate information to the villagers, develop the rural economy and provide job opportunities in the rural areas.

The TeNeT group developed a WLL product using this technology, in collaboration with Midas Telecommunications Pvt Ltd, a telecommunications start-up incubated by TeNeT, and Analog Devices, USA. In the early 2000s, the corDECT technology became a good example of a successful transfer of technology from the lab to the industry, when it was selected by major telecom corporations in India, such as BSNL and Reliance Communications.

The TeNeT model is rooted in indigenous technology and social entrepreneurship. This model essentially works as a three-tier architecture, much like the MSSRF's VKC project described earlier. Tier 1 consists of n-Logue, a company incubated by the TeNeT group. n-Logue acts as the overall technology provider as well as synthesizer of data from the government, educational institutions, banks, hardware and software providers and so on. n-Logue is the overall manager of the network and provides the necessary technology and business support to the next layer, which is the 'local access provider' (LAP) layer.

n-Logue's business model is to use the WLL technologies from Midas Telecommunications to set up a series of WLL transmission towers located at the village-level district headquarters. Each of these centres would then be an LAP (Tier 2), providing services to Internet kiosks that would be set-up in

the villages (Tier 3). The village kiosks would communicate to the LAP centre through a transmission tower and antenna. The village kiosks form the third tier of the architecture. They are connected to the LAPs by WLL receivers (antennae mounted on top of the kiosks).

The TeNeT group's approach, like the MSSRF's VKC project, is to bridge the rural information gap by creating village-level kiosks that would act as information resource centres to the locals. However, the business model is different. Unlike MSSRF, which is purely development-oriented model largely funded by aid agencies and NGOs, the TeNeT model envisaged the creation of rural entrepreneurship at two levels: the LAP level and the village Internet kiosk level. This, it was hoped, would provide a sustainable model for rural development.

The social entrepreneurship model promoted by TeNeT

In this model, n-Logue would sell the Midas corDECT WLL technology to a local entrepreneur at a district headquarters or similar town that has fibre-optic connectivity provided by BSNL or other telecommunications company. The LAP would run a centre that would have the corDECT switch developed by Midas and computers that served information, maintained the network communications status, email and so on. Setting up an LAP centre would cost Rs 1,200,000 (or about US\$26,000), and the village-level kiosks (named 'Chirag' – which means 'lamp' – kiosks) would cost about Rs 50,000 (or about US\$1,100) (*The Economic Times* 2002) and would have the following: touch typing tutoring software, computer education software, photography and movies on CD, desktop publishing, Microsoft Office suite, email/voice & video mail, e-government access facilities (to access, fill and submit government forms such as birth and death certificates, land deeds etc.), rudimentary video conferencing facilities, tele-medicine and veterinary diagnosis facilities, agriculture-related information and so on. The cost would also include training and maintenance.

Unlike the MSSRF model, the local entrepreneur who owns and operates the Chirag kiosk will charge for the use of these services. This is the model of social entrepreneurship that the TeNeT project aims for. According to Dr Jhunjhunwala (2004), Director of TeNeT, this model is most likely to succeed and make rural India into engines of growth. In Jhunjhunwala's view, ICT for rural development based on the financial aid and grant models will not scale as well as or as efficiently as the social entrepreneurship model, which lets locals decide on the types of services offered and set charges for such services.

The bouquet of services offered

This model of social entrepreneurship wedded to ICT also provides flexibility in terms of the type and variety of applications and services provided to a target community. In order to promote, nurture and mentor social entrepreneurs in the

rural ICT arena, TeNeT created the Rural Technology and Business Incubator (RTBI) in October 2006. RTBI's focus is on rural programming, development, technology and business incubation. It has divided the rural ICT and development sphere into the following 'venture sectors', namely, agriculture, vocational training, financial inclusion, education, energy and water management.

As mentioned earlier, RTBI's role is to develop, enable and mentor social entrepreneurship using the technologies developed at TeNeT. For example, using the n-Logue kiosks, a Chirag operator could focus on providing veterinary services via the Internet. Videos and photographs of sick animals could be transmitted for synchronous long-distance consultation from veterinary specialists located elsewhere. In this case, video and photographic equipment may have to be installed. Similarly, long-distance health care for humans can also be facilitated by providing equipment for blood-pressure checking or ECG at Chirag centres, the readings of which could be transmitted instantaneously through Internet-based video and audio-conferencing to medical experts, who could then make a more reasoned diagnosis. In the commercial realm, low-cost bank ATMs can be placed in the centres, with the available network connectivity. Farmers could request and get advice on crops to plant for the next season, prices of commodities in the market, and crop diseases from qualified agricultural experts. Other applications include vocational training and education.

Field visit: Thiruvallur

Thiruvallur is a town located 42 km from Chennai. The town also serves as the headquarters of Thiruvallur District in the state of Tamil Nadu. The approximate population of the town is 50,000. Thiruvallur is the location of an LAP. The Thiruvallur LAP served thirty-two active kiosks at the time of the field visit on 5 December 2007. The Thiruvallur LAP is an example of a failure of the social entrepreneurship model. The operator of the LAP centre had presumably abandoned the project, and the operations were thus being taken over directly by TeNeT, under the supervision of Ms Scotlin (a project officer for TeNeT RTBI).

The LAP centre acted as the control centre that monitored the connectivity status of the village kiosks (Chirag centres) that were served by it. The LAP also attended to complaints from kiosk operators in the villages as well as requests for technical help in repairing fixed relay stations (FRS), which are essentially the antenna that connects the village kiosks to the LAP centres. The LAP acted in conjunction with n-Logue, the provider of the corDECT hardware as well as applications.

The LAP centre is located in a small building near the centre of the town. The distinguishing feature is the imposing n-Logue transmission tower (which is generally taller than wireless transmission towers as the signals have to reach a distance of 25 to 30 km). The building houses the corDECT switch, modems

and desktop computers. One of the desktop computers is connected to the switching equipment to monitor the status and performance of the transmission through modems, repeaters and the kiosk antennae.

During the field visit, two n-Logue technicians were getting ready to visit some Chirag kiosks in the surrounding villages in response to requests for service from the Chirag operators. One of the Chirag kiosks that I visited was located in a small village, Chinnammamet. The village did not have any paved roads, and even though it was located within 15–20 km of Thiruvallur (the district's headquarters), the village is very rural and underdeveloped.

The Chirag kiosk in Chinnammamet was (at the time of the field visit) operated by Mr Anandan. The kiosk consisted of a couple of desktop computers, which had Internet browsing applications, typing lessons as well as desktop publishing tutorials. The centre had the n-Logue antenna mounted on its roof.

The kiosk was a 'for-profit' operation, and all services such as web browsing, email, computer games, computer-aided lessons, scanning and so on had separate service charges, listed inside the kiosk. The kiosk operator, Mr Anandan, did not seem very happy with the technology and support provided by n-Logue. During the interview, he indicated that there were chronic connectivity problems, which were not conducive to attracting students who could use the centre. He only had five registered students at the time. He was operating at a loss.

I accompanied the n-Logue technicians and visited several Chirag kiosks during the day. In all the village kiosks that I visited, the problems seemed to be the same: connectivity issues and service issues. These were accompanied by competition from other similar kiosks located in the vicinity. It was also the case that some of the villages were connected to broadband Internet services by cable operators using satellite dish antennae, thereby nullifying the usefulness of the Chirag kiosks.

It was clear that the entrepreneur operating the kiosk at Chinnammamet was not making a profit. His ability to serve some of the community's 'needs' was limited, and the technology seemed inadequate. It also seemed clear from interviewing him that he had been promised much more technical assistance, and the sustainability and attractiveness of the project had been oversold to him. The kiosk also did not have direct communications facilities with the LAP centre at Thiruvallur. All communications, complaints and service requests had to be handled using private cellular phones. There was no transfer of knowledge between the LAP and the Chirag kiosk, nor were there any training programs offered to the operators of the kiosks.

Field visit: Mayiladuthurai

Mayiladuthurai is located 281 km south of Chennai and is a town in Tamil Nadu's Nagapattinam district. The field visits were done in February 2008.

The LAP centre located in this town offered a contrast to that in Thiruvallur. The LAP is considered a successful example of TeNeT's ICT4D efforts. The access centre is operated by Mr Vijay Iyer, a local entrepreneur who runs the centre professionally. The centre employs a full-time sales person and has its own technical lead person and technical assistants and other office staff. The centre has the capacity to operate 200 connections (to village 'Chirag' kiosks) and is currently operating 75 such connections. The centre provides connectivity to not only village kiosks but also to the office of the district's Chief Administrative Officer (Collector). The Collector's office uses the connectivity provided by the access centre as a secondary mode of connection to the rest of the community and the world.

The LAP's centre operates on the principle of offering quality service to its customers. Accordingly, it strives to keep delays in service to a minimum. The focus is on rapidly getting a non-functioning system back to working condition. The centre offered two types of service: 75 hours of connectivity for Rs 550 per month or unlimited hours for Rs 1,000 per month. Mr G. Ashokan, the centre's sales officer, acknowledges the increasing reach of Internet services offered by the state-run telecommunications company, BSNL. BSNL has gradually been increasing its offerings to more and more rural areas. However, Ashokan says that the service offered by his centre was superior to that offered by BSNL, which proved to be a competitive advantage. During the interview with the centre's staff, I also got the impression that the management of n-Logue was not very responsive to their needs and that it was the initiative and drive of the owner, Mr Vijay Iyer, that enabled the centre to get appropriate and reasonably quick responses from n-Logue. This included technical service as well as training in the n-Logue technology.

The centre's transmission tower was mounted on the building roof, and the centre has desktop computers, corDECT switch and modems like the other LAP centres I visited. The access centre provided support to various Chirag kiosk applications such as web browsing, email services, printing, games, education and desktop publishing software. Mr Ashokan explained that because of the quality of service provided by the access centre, one or two new Chirag kiosks were opened every month. Advertisements placed in local newspapers were the primary selling technique, in addition to direct-person canvassing. Mr Ashokan explained that in order for an access centre to succeed and make a profit, it was critical to select the right person to open and operate Chirag village kiosks. The village kiosk operator should have the necessary business acumen, communication abilities and sufficient finances to operate the kiosk successfully. I inquired about caste-related accessibility issues in the villages where Chirag kiosks were located. Mr Ashokan replied that the LAP made sure that kiosks were located in central business areas even in villages, so as to facilitate easy access to all people in a village.

Field visit: Perambur village Chirag kiosk

The Perambur village is located about 15 km from Mayiladuthurai and has a population of 8,000. If the surrounding villages are included, the population that this kiosk serves is 30,000. The operator of the kiosk is Mr Thiagarajan.

The Chirag kiosk consisted of two Internet-enabled desktop computers and a printer. The kiosk also operated a 'Public Call Office' (PCO), which is a public telephone service provided by Reliance Telecom Limited, a large private sector telecommunications company in India. The PCO was connected to the public switched telephone network (PSTN) using a WLL from the nearby town of Mayiladuthurai. The kiosk was connected to the n-Logue LAP's access centre wireless network by a rooftop antenna. The antenna and other equipment were financed by loans from the Khadi Village Industries Commission (KVIC) and the State Bank of India. This kiosk thus had connectivity through two wireless sources – n-Logue and the Reliance Telecom WLL. Thiagarajan seemed very satisfied with the technical service and support he received from the Mayiladuthurai LAP centre (which is also commonly referred to as n-Logue). He rated the overall service as 'good'.

I conducted a detailed interview with Mr Thiagarajan about the operations, uses, impediments and success stories of the kiosk. The details are given here.

The kiosk had the usual collection of desktop publishing software, Internet browsing and Microsoft Office. In addition, the kiosk also offered services like computer-based education, computer games, vision care and video conferencing. Villagers used the kiosk for making complaints or requests for service pertaining to basic rural infrastructure such as roads needing repairs, road paving and electricity service in the villages. The villagers could use the kiosk's computers to do this for a fee of Rs 10 (US\$0.25). They also used the kiosks to connect to government office web sites to request certificates (such as death, birth etc.), and for videoconferencing with family members abroad. (Mr Ashokan explained that the villages surrounding this kiosk had 'exported' several family members to work as labourers in Persian Gulf countries.)

The villagers saw many benefits in using the kiosk but, most importantly, they appreciated the reduced time for managing a variety of personal chores, such as getting a photograph taken (for passport and other identification purposes), filling out government and loan applications, for applying to government jobs, for reading web-based government notices, for filing complaints to local authorities, for birth and death certificates, for land allocation and for online employment renewal. Unlike the MSSRF's VKCs, women did not seem to use the kiosk to obtain general and reproductive health information. Instead, according to Thiagarajan, the village women were provided the information by government health workers who periodically visited the villages and went door-to-door offering the information and services. Thiagarajan also noted

that the village children did not generally use the kiosk, as they were unable to or unwilling to pay the Rs 10 per-hour charges.

Tie-ups

However, while the kiosk did not impact the women and children of the villages, it did act as an anchor for many village-based employment projects in conjunction with n-Logue and private industry. For example, ITC, one of the three largest Indian conglomerates, realized that it could employ rural people to make incense sticks, which is an approximately US\$50 million business in India. ITC collaborated with n-Logue and, through n-Logue's Chirag kiosks, employed village labourers for making incense sticks (ITC's 'Mangaldeep' brand). Marketing support for the villagers was provided by n-Logue. Thus the kiosks were used as a focal point for non-IT related rural employment and entrepreneurship. In addition, Thiagarajan's kiosk also maintained a small lending library with a small collection of books. Users would typically pay a small fee for borrowing a book. This library was also set-up with a tie-up between n-Logue and a book seller. n-Logue has negotiated tie-ups with credit-card companies, which enables the kiosk operators to make online purchases and even offer such services to their customers. There was also a tie-up between n-Logue and the German company Bosch to provide loans to villagers and farmers to buy tools and equipment.

Field visit: Kollumangudi village Chirag kiosk

The village (population of 4,500) is located about 15 km south-east of Mayiladuthurai town. The kiosk serves twenty neighbouring villages, covering about 30,000 people. The Chirag kiosk here is another example of a well-run rural entrepreneurship effort. The kiosk is modelled as a learning centre and consists of a library, a tutoring centre (offering online tutorials), a computer skills training centre and a rural business process outsourcing (rural BPO) centre. The operator is Mr Kasinathan.

The centre has about twenty-five registered students taking computer courses, consisting of both men and women, and some housewives. The courses offered cover IT basics, IT tools, PC troubleshooting, HTML, databases, project management, Photoshop, Tally (financial software), typing and data entry. The centre offers preparatory courses for a diploma in computer applications. According to Kasinathan, many past students who had successfully completed the courses were also waitlisted to become teachers in local government-run schools.

Users of the kiosk, in addition to taking courses, also use the Internet to get information on a variety of subjects. Many use 'Kijiji', a subsidiary of eBay. Kijiji is a network of online communities where local classified advertisements

could be posted (i.e. similar to Craigslist, <http://www.craigslist.com>). They also use the Internet and web browsing facilities to apply for passports and to register complaints against certain government services. Kasinathan also runs a 'rural BPO', performing back-end information searches for <http://www.zook.com>, a provider of real-time information services in mobile space. The BPO currently has two seats, providing services for sixteen hours and employing two part-time workers. In addition, Kasinathan also uses locals to roll incense sticks for ITC, a tie-up facilitated by n-Logue.

Analysis

In the above narrative, I focused on two basic models of rural ICT projects. The MSSRF's VKCs are a purely service-oriented, developmental model that depends on NGOs and aid organizations to provide a plethora of ICT-enabled services to rural areas. The TeNeT n-Logue projects focus on using indigenous technology to provide the last mile connection to rural areas. But this model is completely different from the former. In the TeNeT n-Logue project, the focus is on developing sustainable rural development through entrepreneurship. It was envisaged that the Chirag kiosks set-up in the TeNeT project would provide a variety of services, which would include Internet connectivity and access to governmental and other community-supportive documents and other information. The Internet usage would be charged. In addition, other services such as document preparation, games, printing and some educational services would also be provided, depending upon the individual operator's ability and inclination. I visited many VKCs and Chirag kiosks, in addition to a few VRCs and the LAP centres. I also visited the MSSRF state-level informatics hub in Chennai, the TeNeT group at IITM, Chennai, and the n-Logue headquarters in Chennai. However, in the above text, I chose to feature representative samples of the MSSRF's VKCs and TeNeT/n-Logue's Chirag kiosks. In the following analysis, I combine observations and impressions made at all of the villages visited and collate data from various sources.

Philosophy

Both MSSRF and n-Logue follow the same general philosophy as regards rural development – that is to leverage ICT to connect India's large, underdeveloped rural population with a view to bringing the fruits of development to rural areas and to promote education and well-being among the rural youth.

However, in terms of specific focus, the two differ. MSSRF projects follow a policy of being 'pro-poor, pro-women and pro-nature'. This philosophy

has been explicitly stated by Dr M. S. Swaminathan, the founder/Director of MSSRF. In fact, Swaminathan did not want the village Internet access centres to be referred to as 'kiosks', as the term is generally used more in a commercial context. MSSRF develops locale-specific, demand-driven content, organizes training and awareness activities, establishes links with local institutions and identifies and trains local 'knowledge workers' who will staff the VRCs and VKCs. In Dr Swaminathan's mind, a kiosk was a commercial location or shop where services were provided for a fee. Swaminathan wanted every rural citizen to have access to knowledge as a matter of right. As a result, the MSSRF's VKCs are completely free for the use of all rural citizens. No fees are charged.

The TeNeT model, while fully acknowledging that IT is the main enabler for rural development, follows the philosophy of fostering rural entrepreneurship for sustainable development. This philosophy permeates all layers of the TeNeT projects. Starting from the top tier, n-Logue is a for-profit start-up that uses hardware (i.e. corDECT switch) from Midas Communications. Both n-Logue and Midas have been incubated by the TeNeT group. In the second tier, the LAPs (access centres) are entrepreneurs at the district-headquarters level. Each access centre services twenty or thirty village kiosks (Chirag kiosks), also operated by village entrepreneurs. The Chirag kiosks constitute the third tier. The LAP entrepreneur typically buys the equipment and synthesized databases and other applications and software from n-Logue. The LAP entrepreneur also markets the concept of the village-level kiosk to local village-level entrepreneurs, who pay for the equipment such as computers and the antenna/receivers. In some cases, they also pay for other services, such as maintenance. The village entrepreneur (Chirag kiosk operator) then sells services to the local villagers. Thus, at every level, the TeNeT model provides services for a fee. Accordingly, the types of services offered at the kiosks vary according to demand and the potential to earn revenue. Social development is only an indirect outcome in the approach.

Data communications technology

The two projects differ considerably in the technologies they use. At the top tier, MSSRF uses VSAT antennas to transmit to and receive data from an ISRO's INSAT-3A satellite. The ISRO-MSSRF's VSAT network uses the extended C-band and consists of several 'nodes', which represent the VRCs and various locations, with Chennai as the central node. Each node can transmit data at 1.5 Mbps and receive data at 384 Kbps. At the second tier, VRCs extend the network to the VKC (the third tier) using Wi-Fi, Spread Spectrum, VHF radio and WLL.

MSSRF has been generally flexible to the rapid changes in the telecommunications sector. It has adopted new and emerging transmission technologies whenever possible and appropriate in order to extend the reach of

its knowledge network. In this, it has depended on international aid agencies, the government of India's space and satellite communications infrastructure as well as commercial vendors such as Motorola (for its VHF duplex radio link for transmitting data between VRCs and VKCs, mostly using funding agencies and grants).

However, TeNeT has relied on indigenous technology developed at the department of Electrical Engineering, IITM. This technology, namely, the WLL corDECT switch, is manufactured by Midas Communications, a venture incubated at TeNeT. Midas switches are, in turn, marketed by n-Logue (another venture incubated at TeNeT), which supplies the hardware to LAPs, which have a role similar to MSSRF's VRCs. All the hardware required – such as the LAP's n-Logue transmission tower, the necessary modems, the antenna located at the village-level kiosks, the repeaters that re-transmit signals from the base stations – are supplied by n-Logue and developed by Midas. The results of this approach of using only indigenous technology to provide rural Internet connectivity have been mixed, as shown in the next few sections.

Effects and consequences

In an effort to understand the effects and consequences of the spread of ICT, and more specifically the Internet in rural India, I interviewed numerous subjects connected with these two projects, attended workshops, met and spoke to villagers and reviewed media articles and opinion pieces in journals. I also reviewed much technology policy and rural development literature emanating from the government.

My conclusion is that India's effort at bridging the digital divide and enhancing rural development has only been a qualified success. However, the two projects that I studied experienced varying degrees of success.

MSSRF

During interviews and field visits, I did not hear anything negative about the MSSRF projects. In fact, the MSSRF projects, with their emphasis on determining the needs of a specific village and tailoring their offerings to that village, along with their focus on poverty reduction through the enhancement of village women, are clearly a success. All the VKCs that I visited were operated by women, who seemed enfranchised and empowered, and enjoyed the status of provider of needed services to the villages. These women were aware of the world and environment around them. They attended training sessions, regional and national workshops and even attended some international events, with funding provided by MSSRF or an international aid agency. They were clearly those who completed at least a basic level of school education and were able to show aptitude in computer applications. They, thus, could be considered

as model figures for aspiring youngsters in the villages. At the least, they were self-sufficient.

The children in these villages definitely benefited directly from the VKCs. They used the VKCs to undergo online and computer-assisted training in various subjects, play computer games and browse the web. They also used the Internet connectivity to check their government-school examination results.

The village men who were interviewed seemed to benefit from the VKCs only partially. While aware that the VKCs provided information pertinent to them, such as weather and commodity prices information, and animal husbandry and agricultural information, they seemed to suggest that such information was also available to them through their cellular phones. Cellular phones are rapidly spreading all over India, including rural India. In fact, cellular telephony has clearly transcended the urban–rural divide in India, aided by favourable government policies that have resulted in very low acquisition costs to the rural populace. Over 11 million new wireless subscribers were added in the month of June 2009 alone (*The Economic Times* 2009). Many governmental and NGO-operated websites as well as telecommunications companies provide such information through ‘short message services’ (SMS) facilities. During the period of the study, a majority of men using the VKCs primarily used them for letter writing, printing documents, loan applications and so on.

According to A. Masilamani, a doctoral candidate at IITM who is researching the effects of rural technologies in south India, there were still some lingering and unresolved issues with the VKCs. The first was the connectivity issue. In Masilamani’s opinion, connectivity problems often hindered more extended use of the VKCs. The connectivity problems were caused by poor supply of electricity in the villages, poor communications due to malfunctioning equipment and adverse weather conditions. At least one of the VKCs that I visited (Thirukanchi) did not yet have Internet connectivity. Thus this village was unable to access web-based information (such as examination results). In order to get such information, the VKC simply requested the Pillayarkuppam VRC or a neighbouring VKC for the necessary information, which was then relayed to them in disks or CDs by human messengers. Other information requested by this VKC was simply conveyed by the VRC by telephone, which was then conveyed to the village through the public address system.

Another problem noted by Masilamani was the persistence of caste-related issues in the villages. Despite MSSRF’s intense efforts at preventing caste-based issues from limiting the access and use of the VKCs, and the ‘equal and unrestricted access’ commitment agreed to by the villagers, both Masilamani and I observed that there were strong caste-based undercurrents in some of the villages. Most villages in Tamil Nadu and Puducherry have a Dalit (or lower caste) ‘colony’, often situated a short distance away from the main town or village. This locational separation is historical, dating from the days before India banned the practice of the caste system in 1950. Despite

governmental efforts to bridge the gap between castes, the problem has persisted and prevailed. 'Lower caste' villagers often expressed a discomfort in visiting and using VKCs located in the 'rest' of the village populated by 'upper castes'. In some cases, an entire village is inhabited only by lower caste Dalits (e.g. Thirukannur, Thirukanchi and Abishekakuppam). Villagers who were interviewed in Thirukanchi revealed that despite the facilities available at the VKC and the clear utility value, upper caste people living in neighbouring villages (which did not have a VKC) did not come to the Thirukanchi VKC. Senthil Kumaran, project manager of the MSSRF project, noted in an interview that in the early days of the MSSRF project, VKCs were located in private houses. However, that practice was discontinued as it led to problems. In some cases, the problem of unequal accessibility was caused due to caste divisions. In some other cases, it was 'class' (or wealth) based.

Masilamani also noted that the success of a VKC finally depends on its perceived usefulness to families and the community. This notion of usefulness to the family and community is paradoxical to the philosophy of rural development and poverty reduction that has been espoused by MSSRF. For instance, the people who were interviewed in the villages almost uniformly stated that they use the VKC and VRCs to gain knowledge and an education (through training and certification), with a view to *leaving* the village for an urban area to seek work. In fact, many of the farmers interviewed stated that in the future there would be no independent farmer, as all cultivation and agriculture would be taken over by commercial conglomerates. Thus, the *raison d'être* for the MSSRF project could become detrimental to the growth and prosperity of villages and village communities, if the same villagers leave the village for better opportunities in urban centres after gaining knowledge through the VKCs and VRCs!

On the whole, the MSSRF project was given a positive reaction by the interviewees. However, reactions to the TeNeT project were not as uniformly positive.

TeNeT

Prior to visiting TeNeT's sites, I interviewed several of its project associates. One piece of information that I gleaned early in these interviews was the fact that the Chirag kiosks were not doing very well in terms of sustaining themselves. According to Mr Anamoy Ranjan, CEO of n-Logue, the company was founded in 2001 and rapidly expanded and set up almost 3,000 kiosks by 2004. However, by 2005–6, the failure rate of these kiosks started increasing rapidly. By 2007, many of this study's interviewees put the number of active kiosks to be under 100, even though an exact number was not available. Partly to address this decline, TeNeT started another initiative called the RTBI in mid-2006. The RTBI focused on enhancing the viability of rural kiosks by focusing on a few

core areas, such as basic education, health, agriculture, vocational education, financial inclusion and enhancing occupational and livelihood opportunities.

The project associates interviewed during this study were involved in one or more of these focus areas and were conducting field studies on how the existing rural kiosks could be tailored (or retrofitted) to serve one or more of these focus areas. This project was in its initial stages during the period of the study. I undertook field visits of existing kiosks in the Thiruvallur and Mayiladuthurai districts to study their functioning.

My observations in the Thiruvallur district led to conclude that the Chirag kiosks there were functioning sub-optimally. Their impact in spurring rural entrepreneurship, much less rural development, was questionable. According to Scotlin (a project associate at the RTBI), the problem was primarily due to poor management. At the time of our meeting, Ms Scotlin was overseeing the management of the LAP centre in Thiruvallur, as well as the kiosk operators and technicians, because the real operator of the LAP had abandoned the project and absconded. The poor management resulted from a variety of reasons, often emanating from the top, that is n-Logue, the technology provider. n-Logue was faulted by many interviewees for not undertaking a rigorous selection process in selecting the entrepreneurs who applied to operate the LAP centres. Some of the entrepreneurs were 'fly-by-night' operators purely motivated by the possibility of earning quick profits, rather than developing a gradual and sustainable business. They neither understood the technology nor attempted to provide 'out-of-the-box' solutions. The LAP operators frequently oversold the merits and profit potential of village-level Chirag kiosks to rural entrepreneurs who were often untrained and technically underprepared. In some cases, the LAP operators sold the kiosk services to the village entrepreneurs and abandoned the project, causing great financial losses to the village kiosks operators who were not financially well off in the first place.

Scotlin stated that there were rampant management problems with the LAPs. There were inadequate numbers of people to manage the LAP centres, and some were hobbled by corruption and 'get-rich-quick' motives mentioned above. Scotlin also debunked the idea that the kiosks were used for development-oriented activities. She stated that most of the kiosks in the Thiruvallur district were not used by women or girls even for the purposes of computer-assisted tutoring. Instead, many of the kiosks were being used only to play computer games. Anandan, one of the kiosk operators, mentioned that connection problems and inadequate service by n-Logue were primary reasons for his failing kiosk.

In some cases, the kiosks were merely used as excuses or proxies to demonstrate the presence of technology rather than their usability or usefulness to rural development. For example, the Besant LVR Teacher Training Institute at Veeraraghavapuram maintained a kiosk that was used by just one operator/technician. My impression was that the training institute maintained the kiosk

as proof of the availability of computer and Internet access to students, even though it was not used by the students at all! In some villages, n-Logue kiosk operators had to compete with other Internet kiosks set-up by other funding agencies and NGOs. In most of these cases, the other competing kiosks adopted more up-to-date commercial communications technology (such as cable-based Internet connectivity). This provided better connectivity performance than n-Logue's technology. However, since the Chirag operators had already invested large sums of money into the n-Logue technology, they were thus locked into what increasingly appeared to be obsolete or underperforming technology.

Anamoy Ranjan, n-Logue's CEO, attributed the high failure rate of the Chirag kiosks to the fact that n-Logue did not have an adequate set of products and services (such as education, health and agriculture) to offer to the kiosks. He acknowledged the efforts taken by RTBI to address this deficiency and mentioned that the easiest application area to enter would be education. He felt that online tutorials for the high school examinations would do well and that parents would be willing to pay for their children's education.

However, at the time of the interview in March 2008, he was still unsure about the actual bouquet of products that would be offered by n-Logue (and thus the kiosks). Ranjan stated that 'in markets where one has never been, there will be a process of gradual discovery to find out what products work, etc.' He also stated that the entrepreneurial model would succeed better with kiosk operators who had a reasonable educational background than those who did not have any such background. The question, however, is whether n-Logue and the kiosks would come up with the list of products soon enough to prevent further failures. Ranjan also did not mention the inadequacies of the technology (such as poor connectivity) and poor service that were pointed by various kiosk operators.

Overall, Ranjan felt that the n-Logue project's impact was limited because the kiosks were not benefiting everybody in the villages. Only a few benefited from them – mainly students who used them for education, to improve test scores and for fun. He also continued to feel that the entrepreneurial model would work best in larger villages (rather than the smaller ones) as they offered more scope for making money.

Of the various TeNeT sites I visited, those associated with Mayiladuthurai seemed most satisfied with the technology and business potential offered by TeNeT. This was apparent during my own experiences at the Mayiladuthurai LAP centre and the visits to the village kiosks in the surrounding villages. The LAP centre is run by Mr Vijay Iyer, a local entrepreneur. He is assisted by his sales point-person, Mr Ashokan. Out of the LAP's capacity of 200 kiosk connections, seventy-five were operational in 2008. The Chirag kiosks that I visited were well run, and there was evidence that they offered suitable business and revenue potential to the entrepreneurs who operated and owned them.

According to Ashokan, even four years earlier the villagers around Mayiladuthurai had no knowledge of the Internet. However, by early 2008 (when I made field visits to the area), almost all villagers knew about the Internet. One primary use of the Internet communications was to communicate with relatives who lived abroad, either using email or conferencing.

The A2K Index

The A2K Index proposed by Shaver (2007) and mentioned earlier is an important effort to quantify A2K as well the developmental effects of such access. The index looks at A2K from five broad categories: education for literacy, access to the global knowledge commons, A2K goods, legal and policy framework, and effective innovation systems. Each category is divided into one or more measurable *areas* (e.g. the category 'A2K goods' consists of measurable areas such as 'affordability of knowledge goods' and 'purchasing power'), which are further fine-tuned into *measurable indicators* (e.g. access to medicines, cost of Internet connectivity, number of cell phone subscribers etc.). (See Table 5.1.)

While the study was not based on these specific indicators, I think that it would be illustrative to apply the findings to the indicators, at least in a qualitative sense.

Education for information literacy

The measurable areas in this category are 'educational achievement' and 'informational literacy'. In this study, it was found that informational literacy was clearly a focus of the MSSRF project. While educational achievement was not a direct focus, the presence of programmes such as the MUPP and other information such as that pertaining to farming, training in livestock and animal husbandry, and the access to information pertaining to women's and children's health all pointed to efforts in appropriate rural education. This intensity of focus did not exist in the TeNeT programmes, where the focus was more on creating revenue streams through offering services.

Access to global knowledge commons

Both the MSSRF and TeNeT projects aimed at providing Internet access. There were efforts to provide web-based information in local languages, rather than expanding the linguistic fluency of the rural populations that they served. Over time, it was clear that these populations attained a fluency in the terminology of computers, the Internet and the web. There were, however, some indications that some of the TeNeT kiosk operators were not as focused on enabling their customers to attain Internet terminological fluency as they were interested in making a profit from the venture. To that extent, it would seem that MSSRF,

Table 5.1 Access to knowledge indicators (from Shaver 2007)

Category	Area	Indicator
Education for information literacy (IL)	Educational achievement	Secondary education completion
		Tertiary enrolment rates
	Informational literacy	Direct assessments of IL
		Survey using proxies for IL
Access to the global knowledge commons	Linguistic fluency	% speaking a global gateway language
		Weighting languages by knowledge base
		Survey of linguistic fluency
	Internet access	ITU estimated Internet users
		Survey of actual Internet users
		Digital divide indicators
A2K goods	Affordability of knowledge goods	Access of essential medicines
		Cost of Internet connection
		Number of cell phone subscribers
		Cost of basket of knowledge goods
		Survey of A2K goods
	Purchasing power	GDP per capita, adjusted for purchasing power parity
Legal and policy framework	Freedom of expression	Freedom house civil liberties score
		A2K freedom of expression score
	Balanced IP regime	IP protections exceed international norms
		Scope and effectiveness of exceptions
		Conformance to model IP policies for A2K
Effective innovation systems	New contributions to knowledge	Survey of innovation in public centres
		Survey of innovation in private firms
		Metrics specific to high-value innovation

with its clear focus on development and poverty alleviation, scored over TeNeT in the area of achieving linguistic fluency.

A2K goods

It was not clear from the study of both projects if such A2K projects really enhanced the purchasing power of the target populations. 'Knowledge goods' can include medicines, cell phones and Internet connection costs, to name a few. In India, these are not strictly within the purview of these projects. Rather, these are controlled by the government through appropriate policies and ministerial interventions. One important policy result has been the setting up of 'common service centres' (CSCs) in most of India's villages through a public-private partnership. Implementation of the CSCs started in earnest in late 2008, and a discussion of its structure, implementation, success and failure is outside the scope of this chapter. Both the projects thus provide access to the Internet, at costs that have been designated by the government. But such access was free to users in the MSSRF project, whereas the TeNeT project charged customers for Internet connectivity.

Legal and policy framework

The issues of freedom of expression and intellectual property (IP) protection, which fall within this category, affect the MSSRF project only indirectly. It can be argued that increased A2K ensures that the populace is more aware of protected and fundamental rights in a democracy. From that viewpoint, both MSSRF and TeNeT enhanced the freedom of expression. The issue of IP protection does not play a big part of MSSRF, as it clearly uses both indigenous and imported technologies only in the form of aid from philanthropic and developmental agencies. TeNeT, however, focused on developing indigenous technologies, which were then spun off to create technology start-ups. These projects were within the purview of legal IP regimes. Over that past decade, urged by the World Intellectual Property Organization (WIPO), India has adopted wide-ranging policies towards ensuring IP protection that meets international norms.

Effective innovation systems

The TeNeT project, with its focus on developing appropriate indigenous technologies for rural applications and development, has proved to be a leader in innovation and has provided a platform for newer innovations in additional application domains. However, the TeNeT technologies have also come under criticism for not being robust enough and failing too frequently, as noted earlier. One of the biggest complaints about TeNeT technology was that while it worked well enough in the laboratory, it failed under real-life conditions. This could have been due to inadequate testing and lack of quality control procedures. Interviews with many associates in the TeNeT project also indicate

that there was too much focus on ‘going it alone’ and developing end-to-end products even when newer technologies became available over time from foreign manufacturers. Thus, one can say that even though TeNeT provided a platform for innovation, and was focused on indigenous innovation, the overall innovation climate has not gained just from the TeNeT project. Innovation is a national prerogative and should therefore be a collaborative effort jointly achieved through government and private and public partnerships.

Conclusions

Early in this chapter, I set out the following objectives:

- to study and analyse two types of rural ICT4D projects in southern India, focusing specifically on the rural knowledge creation, management and dissemination aspects;
- to report the results of a field study comparing the two models and factors that influence the success or failure of the two types of projects.

In the preceding discussion, I have attempted to analyse the two models of ICT4D projects in rural India. By the end of 2010, approximately 108 MSSRF’s VKCs and 18 VRCs were operating successfully, according to Subbiah Arunachalam, a fellow at MSSRF (Arunachalam 2010). By contrast, only a handful of TeNeT Chirag kiosks were still in operation, even though there had been hundreds of such kiosks even two years earlier. Based on this fact, and the discussions in the earlier sections, it would be tempting to conclude that the purely community developmental model of MSSRF has proven to be more useful and successful than the social-entrepreneurship-based, indigenous-technology-focused TeNeT model.

However, such a conclusion would be too facile. The story of ICT4D projects in India is more complex. For instance, it is quite possible that proper screening and adequate training of the n-Logue LAP franchisees helped in achieving a better success rate for TeNeT’s Chirag kiosks. In addition, if TeNeT had been able to accept earlier that its indigenously developed technologies were not adequate in the field, then remedial actions could have been taken. The following were some of the problems with n-Logue’s ‘offerings’ that kept coming up in many interviews with TeNeT project associates:

- poor and underperforming technology;
- lack of appropriate selection and training of franchisees;
- power shortages in rural areas, which further adversely affected the performance of n-Logue equipment;

- the lack of good ‘application products’;
- inadequate bouquet of products and services, with the model of services offered varying widely across kiosk operators – no standard franchise model;
- poor marketing;
- inadequate translation of management’s vision;
- a technology-focused hubris that seemed to emanate from the project’s leaders, who refused to accept some of the technology’s failures and seemed to believe that technology could solve all problems;
- failure of the project’s leaders to foresee the proliferation of cellular telephones in rural India, which nullified some of the relevance of the Chirag kiosks’ abilities to be an information resource to rural communities.

Despite these glaring problems, I encountered some successful Chirag kiosk and LAP operations, such as those in Mayiladuthurai. The critical success factor here was the entrepreneurial drive and marketing ability of the LAP operator, Vijay Iyer. He was a college-educated businessman who was able to get together a good team of locally savvy sales persons and technicians. He carefully cultivated relationships with local governmental authorities. He often travelled to the n-Logue headquarters in Chennai and demanded that his technicians be given adequate and timely training. He also made sure that n-Logue technicians responded promptly to his service requests.

One could thus conclude that a mix of education, business knowledge, social stature, appropriate contacts in the local government, persistence in getting service from n-Logue and drive in educating customers and the village kiosk operators, and providing an appropriate product mix to these operators all helped in the success of Iyer and the Mayiladuthurai TeNeT LAP.

The MSSRF project has generally enjoyed more success than TeNeT project. Some contrasting features of the MSSRF project, vis-à-vis the TeNeT project, are as follows:

- MSSRF’s VKCs are not focused on any single individual entrepreneur but on a whole village or community.
- The entire village community has to ‘buy into’ the project.
- An ‘advance team’ develops a relationship with villages over a period of at least six months before setting up a VKC.
- The focus is on community development and poverty alleviation, not on profit making;

- MSSRF was not wedded to any specific technology. It may be noted that right from the start, MSSRF used multifarious technologies acquired from the private sector (i.e. the Motorola VHF duplex radios, satellite transmission and VSAT antennas from the ISRO). More recently, noticing the rapid spread of cellular telecommunications services in India, MSSRF has teamed with cell phone providers to offer some service to rural communities.
- MSSRF has also made sure that it offers a rich bouquet of products and applications leveraging all of the above technologies.
- In my observations, I noticed that MSSRF offered a high level of support to the VRCs and VKCs – in contrast to the TeNeT project.

Despite the success of MSSRF projects, it is quite questionable that a purely developmental model that depends only on external funding agencies may be sustainable in the future. This is especially so in the context of the rapid proliferation of cheap cell phone-based services offered by telecommunications companies. Given that cell phones can ‘push’ a variety of information relevant to the specific needs of various communities using publicly available data, one can question the very reason for existence of VKCs in rural areas. Why should villagers depend on information from a VKC, when they can get the same information from their cell phones? Thus, it is not clear whether the advent and rapid expansion of cell phone usage would completely kill the VKCs. An additional worry is the possibility that funding for many of the VKC projects may dry up eventually.

Subbiah Arunachalam (2010) mentioned in interviews that in states such as Maharashtra MSSRF is slowly moving away from the ‘free’ service, community development model, to a fee-based model. In his view, the MSSRF’s VKCs offered specific, appropriate services to targeted rural populations through its VKCs. Thus, the target populations would be willing to pay for such services that could not entirely be provided by cellular telephone companies.

In conclusion, I believe that, overall, the MSSRF project has proven to be more resilient and adaptive to changes in the environment and has thus survived and continues to provide services to rural India. TeNeT has suffered adversely from the fallouts arising from poor technology, lack of adaptability and poor management and vision. It would be interesting to study if the MSSRF model would survive in the future or be consigned to history. Keeping this in mind, I have developed a list of questions around which I plan to develop hypotheses to test in future studies:

- 1 How are rural development projects keeping up with the exponential developments in technology?
- 2 How to compare the effectiveness of the different models adopted by rural ICT projects?

- 3 How sustainable are the 'community-oriented' projects, especially when funding from international aid agencies dry out?
- 4 What are the real costs and benefits to society at large from rural development projects, and how to quantify them?
- 5 What are the limitations of such projects, and what could be the reasons for the same?

I hope that this study and the questions posed will provide the basis for further research in this field.

Notes

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- 1 India's GDP growth in the year 2010 was 8.6 per cent (*The Economist* 2011). Its growth rates in the industry and services sector were 8.2 per cent and 8.7 per cent, respectively (Ministry of Finance 2011).
- 2 TeNeT is the Telecommunications and Computer Networking Group in the Department of Electrical Engineering at IITM. The TeNeT group's vision is to develop 'world class technology at an affordable price'. TeNeT has incubated numerous ICT4D projects.
- 3 n-Logue is a start-up incubated by the TeNeT group. Its business model is to use WLL technologies from Midas Telecommunications (another start-up incubated at TeNeT) to set up a series of wireless transmission towers at district headquarters to connect villages.
- 4 DHAN is an NGO focused on rural development in south India, located in the city of Madurai, in Tamil Nadu State.
- 5 It is interesting to note here that the rural students were taught material that was almost similar in content to that used at the elite Indian Institute of Technology's Information Systems course, where this author taught during the Fulbright Grant period. Only the language of instruction was different.

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