Information Technology and Rural Development in India*

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Abstract

How can information technology (IT) contribute to rural development? What are the channels through which impacts can be realized, and what are the practical means for realizing potential benefits? This paper examines several ongoing projects that aim to provide IT-based services to rural populations in India. These projects are distinguished by the goal of commercial sustainability, which supports scalability and, therefore, more widespread benefits. The analysis highlights the common building blocks required for successful implementation, and the relative strengths and weaknesses of different approaches.

Keywords: India, information technology, Internet, rural development

JEL codes: O12, O3, L31, P2

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1. Introduction

It may seem paradoxical that modern information technology (IT), associated in our minds with developed country markets and capital-intensive methods of production, has any relevance for a country where many millions still lack basic needs. Nevertheless, there are many efforts underway in India and other developing countries to demonstrate the concrete benefits of IT for rural populations, and to do so in a manner that makes economic sense.[1]

This paper outlines the conceptual and empirical case for the use of IT in India's rural development. Section 2, provides a broad discussion of the potential role of IT in broad-based economic development. Section 3 examines the conceptual issues from the perspective of demand for, and supply of IT-based services to rural populations in a developing country. Section 4 discusses the lessons of some of the efforts underway in India, including the work of Aksh, Drishtee, ITC, n-Logue and TARAhaat. Section 5 is a brief conclusion.

2. IT, Economics and Development[2]

In abstract, there are two types of potential economic gains from the use of IT. First, there are both static and dynamic efficiency gains. Static gains are one-time, and come from more efficient use of scarce resources, allowing higher consumption in the present. It is useful to distinguish two kinds of static efficiency gains. One kind pertains to increases in operating efficiency, while the other comes from reduced transaction costs. In both cases, the channel for gains is through more effective and lower cost

information storage, processing and communication. Dynamic gains come from higher growth, potentially raising the entire future stream of consumption.

The second type of potential benefit comes from reductions in economic inequality, to the extent that such reductions are an agreed-upon social goal, and therefore a social benefit. The two types of gains may conflict, if growth requires increased inequality, or they may be mutually reinforcing, where broad sharing of the benefits of growth enhances the rate of growth. We can discuss the role of IT in achieving greater economic gains along both dimensions, without having to commit to a particular position on the relationship between inequality and growth. However, a focus on using IT for rural development is, at least on the surface, supportive of reduced inequality along with increased efficiency and growth.

Of course, benefits that are measurable as increased market-based economic activity, and hence show up in national accounts statistics, are not the only component of development. Development can also include improvements in the capabilities of the population, such as education, health and nutrition, independently of any direct or indirect economic impact. The ability to participate in democratic decision-making also falls into this category. Broad-based improvements in capabilities can also have positive impacts on long-run economic well being, but this is not a necessary condition for desiring such improvements. The role of IT in effecting improvements along non-economic dimensions is also considered in this paper.

Turning to specific impacts, note that IT involves the electronic processing, storage and communication of information, where anything that can be represented in digital form is included in the term ‘information’. Thus news, entertainment, personal

communications, educational material, blank and filled-out forms, announcements, schedules, and so on are all information. Software programs that process data (searching, tabulating, and calculating, for example) are also information in this sense, representing a particular kind of intermediate good. We can use standard economic characterizations to classify the different kinds of information. For example, entertainment, personal communications, and sometimes news, are final goods. Educational material, job announcements, or some kinds of news (weather news for farmers, for example) are intermediate goods, typically used for improving income-earning opportunities.

Information goods typically have the characteristic that one person's use does not reduce their availability for another person. Thus, a message or weather news can be viewed by many people, simultaneously or sequentially. Depending on the content of the news or message, different people may place different valuations on the information. Only friends and relatives may be interested in a personal message, all farmers in a district may be interested in local weather news, and so on. The ability to share information among users can impact the feasibility of providing it on a commercial basis. IT dramatically increases shareability of information, and this affects the economics of private provision of information goods and services.

The government may provide information goods because they are shareable and non-excludable (pure public goods). The classic example of a pure public good is national defense, but such goods may also be local in nature, such as public parks or law and order. Of course many local shareable goods can be provided exclusively, in which case private provision is a feasible alternative, in a club-like arrangement. Here, government provision may be justified more on equity grounds than on the basis of

failure of private provision. In some cases, government financing through taxes or statutory user charges can be combined with outsourcing of delivery to private providers to achieve both equity and efficiency goals.

Often, private provision is feasible, but neglects the spillover benefits that it creates, in which case government subsidization may be socially beneficial. For example, primary education has private economic benefits that people are willing to pay for, but it can also have substantial non-economic benefits to the individual and to others in the society (improved understanding, ability to make sound judgments, political decision-making capacity, and so on). Additional roles of government that are important to bring out are in redistribution to achieve equity objectives, and in regulation of private activities through licensing and certification. In both cases, the government also uses economic resources, and IT has a potential role in increasing the efficiency of government.

For both government and private provision, one of IT's main direct benefits is in increasing efficiency by economizing on resource use in the operations of firms as well as in market transactions. Information that would otherwise be conveyed through face-to-face contact, post, courier, print delivery, telegraph or telephone may instead be communicated in digital electronic form via the Internet. Efficiency gains from Internet use are not automatic: the telephone, in particular, is an efficient means of communication for many types of information. IT also requires new investment, so the benefits of trips, time and paper saved must be weighed against the costs of installing and maintaining the new infrastructure. Efficiency benefits of IT are not restricted to the communication itself. IT can improve the efficiency of the telephone network, and it can

make it possible to track and analyze communications. Word processing, maintaining accounts, inventory management, and other such activities that may not require long-distance communications are also made more efficient by IT.

Experience with Internet use in developed countries suggests that information exchange related to the completion of market transactions is especially valuable. The ability of IT-based communications (combined with storage and processing) to bring together buyers and sellers more effectively represents major potential gains. These gains can come about through lower search costs, better matching of buyers and sellers, and even the creation of new markets. The successes of auction and employment websites in the US illustrate these gains. In the rural Indian context, farmers selling their crops and buying inputs, parents seeking matrimonial alliances for their children, and job seekers are all potential users of Internet-based matching services.

Efficiency gains of IT can also come about through the enabling of new goods and services. In many cases, the new good is related to something available earlier, but is presented in a form that reduces costs and expands the size of the market. For example, recorded music is a mass-consumption item, whereas only a small minority of the population could afford or have access to live performances by the highest quality musicians. Educational material is another example where recording and duplication can replace more expensive, skilled-labor-intensive alternatives for delivery. The possibilities for interactivity with IT-based educational materials illustrate the advantages of IT over older technologies based only on recording and duplication. Interactivity also implies personalization, in that an individual can select the precise content that he or she wishes to see. This feature also distinguishes IT-based content from what was available through

previous technologies. Finally, the sheer volume of information that is accessible through IT is much greater than before: this also allows new kinds of services to be provided at a cost that is affordable to larger segments of the population.

We have outlined the potential static efficiency benefits of IT, but the direct dynamic benefits in terms of higher growth are harder to identify. Of course, if IT economizes on current resources, more is available for investment, which can increase growth. If IT increases the efficiency of education delivery to the broader population, this investment in people (human capital acquisition) is also likely to lead to higher growth. IT may also have positive impacts through impacts on the innovation process. For example, IT can make innovation easier by allowing simulation and low-cost testing of new designs or searching through possible chemical compounds for beneficial drugs. Finally, IT may speed the diffusion of innovations through better communications, which may stimulate further innovation – though this last channel is speculative.

An important barrier to realizing the economic benefits of IT is the often-substantial up-front cost of investment in new infrastructure – both hardware and software. In developed countries such as the US, large potential customer bases and efficient capital markets help overcome this barrier. Hardware and software designed for developed country markets can easily be adapted to serve higher income consumers in developing countries, but this leaves out the majority of the population in developing countries. Thus, one potential consequence of IT is an exacerbation of inequality, as only higher income groups enjoy its benefits – this is the so-called ‘digital divide’.

On the other hand, because government-provided goods and services, including redistributive transfer payments, are often aimed at lower income groups, to the extent

that IT can increase the efficiency and effectiveness of government, the benefits of IT will be more widely spread, partly reducing 'digital divide' concerns. However, achieving these benefits requires more than just internal use of IT: beneficiaries of government services (particularly the economically disadvantaged) must be able to access IT resources also. While governments may invest in such front-end interfaces with citizens (and have done so in developed countries), the cost of doing so for governments in developing countries may be prohibitive. Such governments typically already have difficulties in raising sufficient resources through taxes and user charges.

While successful examples of implementation of 'e-governance' initiatives exist[3], there is a conceptual alternative. This comes from recognizing the fact that citizens typically incur private costs (often substantial) in availing of government-provided services. If the use of IT can reduce such costs, even low-income individuals may be willing to pay at least some fraction of the cost savings, and there is scope for private provision of intermediate services that reduce the cost of access to government. Of course, this idea is not specific to IT: private intermediaries already help in filling out forms, getting access, and so on.[4] One difference that IT can make is in reducing costs even further, often by an order of magnitude. In broad terms (as is also the case with electronic marketplaces and job-matching boards), IT changes the scope and nature of intermediation.

Private providers may therefore have a role in delivering IT-based information services that are complementary to government services, as well as in providing conventional private goods and services. However, the private individual benefits that determine the prices charged by private providers may not reflect the overall social

benefits of provision. As discussed earlier, these may include benefits such as greater awareness and participation in the political process. In such cases, there may be a role for government subsidization of private provision. This assumes that government provision is likely to be less efficient than private provision, which seems to be true in some cases in developing as well as developed countries. In either case, richer information flows increase the transparency with which the government operates, thereby promoting better monitoring, and potentially – depending on whether electoral and legal institutions are effective – greater accountability. The ultimate payoff is more efficient delivery of government services.

Looking at the case of India, in cities and larger towns, cyber kiosks have already begun to proliferate. Urban population densities, income levels, cultural attitudes and telecom infrastructure all seem to be sufficient for the commercial success of these enterprises. The falling cost of hardware and the availability of a variety of English language software have also supported this trend. Finally, the government's belated opening up of Internet service provision to competitive entrants has been a crucial supporting development. In non-Internet IT-related services, IT education has clearly taken off in cities as well, inspired by India's success in software exports.

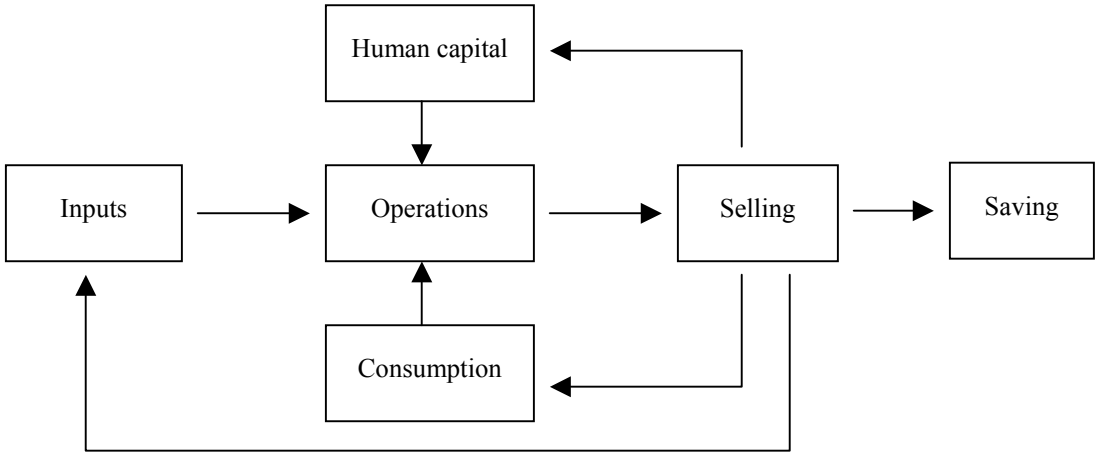
In rural areas and smaller towns, however, the various demographic and socioeconomic factors such as income levels, cultural attitudes, and geographic and social fragmentation may not be present in configurations that would easily enable the diffusion of commercial access to various IT-enabled services. Furthermore, the market power of traditional rural intermediaries may act as a barrier to partial innovations in how matching of buyers and sellers is conducted. Finally, vernacular language requirements

and different demand patterns imply the need for software that is tailored for fragmented rural markets. In the next section, we examine the technical and organizational issues in implementing widespread rural IT use in India.

3. Rural IT: Issues and Conceptual Framework

We examine the potential for rural IT use, both from supply and demand perspectives. On the supply side, we examine the technical and organizational issues that arise for delivering IT-based services to rural populations in India. On the demand side, we examine the potential benefits that IT can bring to these populations, if the implementation is successful. We begin with the demand side, as a way of motivating the supply side issues.

Figure 1: Rural Household Economic Decisions



Potential sources of demand for IT-based services can be framed in terms of a simple flow diagram representing the decisions of rural households. We will treat a

typical household as engaged in farming, though this will not be true for all of them. Figure 1 presents a simplified representation of the various economic decisions.

Beginning from the left of Figure 1, input decisions include material inputs such as seeds, fertilizer and pesticides; and capital inputs such as tractors and land (whether through purchases or rentals); as well as the credit required for such purposes. The focus of analysis will be market transactions for inputs. In all cases, there is a potential for benefiting through improved information about prices, quality and availability. Labor is also an important input, but the labor market has special characteristics that reduce the importance of such information in rural contexts.

Operations include decisions with respect to quantity and timing of inputs. A crucial aspect of agricultural operations is risk management, as both the weather and pest incidence are extremely variable. *Ex ante* decisions in the face of uncertainty, as well as *ex post* responses to realizations of uncertainty are both important. Predictive and technical information are both important for agricultural operations.

Continuing to the right of Figure 1, marketing of outputs primarily requires price information. Increasingly, producing for sale also requires knowledge of quality requirements in different markets. Selling of produce provides income for consumption, investment and inputs (the reverse arrows in the figure), as well as generating information that affects input and production decisions.

Non-production decisions of households can be roughly divided into pure consumption activities, as well as human capital investment in education and health. The boundary is fuzzy, since even basic food consumption has nutritional impacts and therefore a human capital component. These activities generate impacts on operations,

since they affect the quality of decision-making, as well as household labor inputs: we indicate this with the vertical arrows. While poorer households may be severely limited in their consumption, a significant proportion of rural households in India have incomes sufficient to support some discretionary consumption. In some cases, consumption may be only superficially discretionary – social norms may dictate spending on activities relating to marriage and other life cycle events.

Finally, the rightmost box captures household saving, again something that is not feasible for all rural households, but is an activity of growing importance. Saving may be for consumption smoothing, investment, or precautionary reasons.

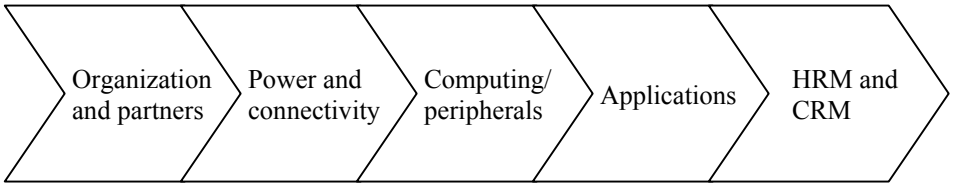
Even this simplified and summary picture of rural households' economic activity illustrates that they engage in a broad range of transactions and decisions with economic impacts. What is noteworthy besides this complexity is that many decisions are made with very limited information, and that market interactions are often subject to high transaction costs, due to imperfections in information, as well as high transportation costs, inefficient intermediation and time delays. High transaction costs will always prevent marginal transactions from being undertaken; in extreme cases, the market may fail to function at all. Given this scenario, the role of IT can be understood in terms of reducing transaction costs, as well as improving the efficiency of decision making within households (both as producers and as consumers).

Reductions in communication and transaction costs are particularly beneficial where they can allow new markets to develop, in the sense that existing goods and services, otherwise restricted to urban areas, or to a very limited segment of rural populations, now can be offered to broad cross-sections of the rural population. Examples

include financial services, particular types of education, health services, long distance communications, and expertise on a range of production-related decisions. Whether this can be done in a sustainable manner depends on the supply conditions for IT-based rural services.

It must be further understood that the activities outlined, in Figure 1 and the accompanying discussion, take place within a particular institutional environment. This includes private actors as well as governments. For example, farmers may obtain credit and inputs, as well contract their output, to private 'commission agents,' even in the presence of government procurement and government-run local markets. Governments play a major role in subsidizing inputs, providing infrastructure, and enforcing property rights. To the extent that these activities are also subject to inefficiencies, it may be the case that, in order to be successful, IT-based interventions geared towards rural households will have to simultaneously alter the institutional environment, or else achieve sufficient scale and scope in order to impel changes in it. We will take this up later in the paper.

Figure 2: Value Chain for IT-Based Services



Turning to the supply side, we can illustrate the various stages of decision-making and delivery of IT-based services in terms of a typical value chain, as shown in Figure 2. At each stage of the chain, the IT components include a mix of hardware, software and

services. In addition, the creation of an organizational structure and value network is a critical first step, while managing human resources and customers is vital for successful final implementation.

We next discuss each of the components of the value chain in Figure 2. The organizational structure typically requires commercial goals of profitability to be built in. This is easily done through a standard corporate structure. It is clear that, for scalability, some minimum size of the organization is required. In addition, there are fixed costs of innovation that can be spread more effectively across a larger organization. Social goals can be incorporated in two ways. For organizations that are dedicated specifically to rural IT-based services delivery, controlling ownership of the corporation by a non-profit entity provides the social focus. For existing corporations with broader businesses, social goals may enhance reputation, meet corporate social responsibility guidelines, or otherwise be consistent with the mission and values of the organization. In other words, including social goals may make good bottom-line business sense.

For both types of organizations, building the right capabilities requires some effort. Creating what amounts to a brand new infrastructure for rural IT service delivery requires a broad mix of skills, and finding talented and trained people who can be effective in a role that mixes entrepreneurial tasks with corporate line responsibilities, all in an unfamiliar rural environment, can be a challenge. One solution to the potentially insurmountable problem of collecting the necessary talent and skills is to enter into partnerships with other organizations that may provide specific pieces of the overall package that is needed: application software, content, maintenance services, technology, marketing, and so on. These partnerships can pose their own problems, particularly in

goal alignment and consequent performance monitoring requirements. Of course all these organizational issues are well recognized in management writing and experience: what is important is to recognize their criticality in a setting that has more typically been the arena of pure 'social service' entities such as governments and NGOs. It is also critical to recognize that the organizational innovation required in this case is an order of magnitude greater than the task of selling consumer goods in rural areas, something that is now accepted as a given in India. The greater complexity and variety of the services being delivered through IT is the root cause of this difference.

The second stage of the supply chain in Figure 2 concerns access to electric power and Internet connectivity. In both cases, a major constraint is the failure of the public sector to deliver adequate power and telecommunications to rural India. Privatization has helped in the case of telecommunications, as has technological change. In fact, innovation in digital communications technologies is the foundation of all rural IT-based service delivery. While conventional telephone connectivity has often proved inadequate for Internet access in rural areas, because the quality of existing voice lines is too poor to sustain data transmission, several innovations provide alternatives that are likely to be cost effective. These include wireless in local loop (WLL), fiber optic cables, and high-powered versions of Wi-Fi (802.11 wireless standards). The Internet boom in the United States clearly played a role in pushing down costs and speeding innovation in fiber optics and wireless transmission. In some cases, VSAT satellite connectivity has been used for Internet access, but it is not very cost effective. The major challenges for connectivity are likely to be regulatory, having to do with interconnection to the main

network, and with maintenance, rather than with the fundamental technological choices and implementation.

Electric power is more of a problem, and this is true throughout India. Battery backups are a very partial solution to the lack of reliable power supplies, and solar technologies may be more promising in the near future: they are already in use in existing rural IT efforts. The difficulty is that having to rely on these alternatives and backups unnecessarily raises costs of operation. Of course this is true for all of India's economy. It is well recognized that the power sector is the major bottleneck, with capacity well short of demand, and the quality of transmission and distribution remaining poor.

The third stage of the supply chain is the most straightforward, because of the standardization of components of desktop computing and peripherals, rapid technological improvements, falling costs of production, and, most recently, price reductions resulting from changes in tariffs on imported hardware. It is now possible to fully equip a single-computer rural Internet kiosk for less than Rs. 50,000, including CD drive, printer, scanner, power backup, and web cam. Potentially, the highest cost component is the operating system, since Windows enjoys a virtual monopoly on the desktop. However, Microsoft seems to have concessional pricing for socially oriented developing country initiatives, and this helps to reduce costs. The operating system is still typically in English, but as long as simple drills can take kiosk operators to local language applications and content, this is not a substantial usage barrier. One can conclude that this stage of the supply chain is easiest to implement, with a highly standardized, almost cookie-cutter approach – although ongoing maintenance can be a challenge. The major

business decision is whether to have more than one computer per kiosk, but experience suggests that one is sufficient for almost all situations, at least in the beginning.

The next stage of the supply chain, namely applications, presents more challenges. The range of possible applications is vast. Many IT-based services require non-IT logistics or processes as complements. Availability of local language software becomes more of a constraint. There is much more variation across localities, not just regions. Delivery of services or development of content often stretch the resources and expertise of the primary provider, and require varied partnerships or other contractual relationships. Deciding the sequencing, scope and sophistication of various applications can be a major challenge, since many of the services are being offered for the first time, or are being delivered in novel ways that challenge existing institutional frameworks and relationships. Pricing for low income markets, where market penetration is limited in any case, and where some services may be perceived as public goods that are traditionally unpriced, presents another major challenge. In the case of financial services or government records or services, substantial government cooperation may be required, raising political and bureaucratic hurdles. In some ways, of course, the essence of the success of the rural IT-based-service business model depends on the selection, quality and pricing of the services being offered. What is interesting is that a substantial amount of learning has occurred in this arena, in just a few years.

The final stage of the value chain in Figure 2 refers to human resource management (HRM) and customer relationship management (CRM). In this context, these more general terms take on specific focuses. Training of rural kiosk operators, whether they are formal franchisees or independent farmer operators, becomes a key

aspect of the delivery model. Training the field personnel at various levels (village and district hub) is also critical. Gathering customer information on usage patterns (nature and timing of use), revenue streams, responsiveness to pricing, social acceptance, and so on is also vital, as these are brand new markets in terms of the nature of service delivery. Furthermore, being able to respond to this information with appropriate and timely changes in strategy is also necessary for successful implementation.

One might expect that a 'labor surplus' developing economy such as India's would not have a problem with the more labor-intensive tasks at either end of the value chain as it has been mapped in Figure 2. However, it seems that these value chain activities are the most difficult to carry out successfully, because those with the requisite skills are more likely to be taken up by more traditional corporate organizations, in urban environments. This does not minimize the challenges associated with technical implementations and adaptations for rural areas, whether in software, hardware and maintenance. However, solutions in these cases are often one-time and replicable, whereas building organizational expertise involves much more of a situation-specific or local approach.

We have so far provided a general and abstract discussion of the various aspects of supply and demand of rural IT-based services. In the next section, this discussion is made more concrete and specific, through an assessment of several initiatives in India.

4. Implementation: Cases, Impacts and Lessons

The discussion of several rural-IT initiatives is based on field visits conducted over a two-year period, from December 2001 to December 2003, as well as discussions

with various members of each organization.[5] The goal is not to provide an exhaustive description or analysis of any single organizational effort, but to use the conceptual framework of the previous section to bring out common features as well as differences. Nevertheless, it is useful to describe each initiative separately, rather than organize the discussion according to value chain components or demand-side factors, as this provides a better sense of each overall effort.

Drishtee

Drishtee.com had its origins in Gyandoot, a government project in Dhar district of Madhya Pradesh, in central India. Gyandoot provided an intranet for 33 village information kiosks, offering a range of mainly e-governance-related services. The most prominent of these is land record certificates, which are needed by landowners for transactions such as sale or leasing of land. While Gyandoot was a specific local initiative, involving heavy support from the District Collector, Drishtee has attempted to take that model and rapidly replicate it across the country. Currently, Drishtee has over 100 rural Internet kiosks in several states, run by franchisees according to a revenue sharing arrangement. In Drishtee's case, a kiosk has, at least initially, just one computer. The set-up cost is in the range of Rs. 50,000.

Drishtee is a commercial organization, with specific social objectives of targeting benefits to the rural poor built into its vision and strategy. Drishtee has developed some software on its own, but also relies on various partners for software development, as well as, in some cases, other partners for management of district hubs, from which kiosks in a district are managed. Thus Drishtee's model involves not only franchising individual

kiosks, but also potentially franchising district hubs. Partnering with local district hub 'channel partners' allows Drishtee to expand faster without creating a bulky organization, spreads risks, and also insulates Drishtee from some of the commercial pressures that might conflict with social objectives. At the same time, it reduces Drishtee's ability to monitor and implement the achievement of social objectives. This tension between commercial success and meeting social objectives is a general challenge for all the rural IT initiatives examined here. Despite some challenges, Drishtee appears to have built a capable but lean organization, with learning having been systematized in a manner that makes it transferable across locations, permitting more effective scaling up.

Electric power and telecom connectivity have posed challenges for Drishtee, since it is a pure startup, without resources for heavy investments in infrastructure. It uses standard battery backup for power interruptions, and has relied mainly on dial-up Internet access, though it is experimenting with Wi-Fi for district-level intranets. In some cases, it has set up kiosks even without phone connectivity, relying on physical delivery of information. Software has also been developed that economizes on bandwidth for information exchange, making the constraint of dial-up access less severe.

As we have noted, the software and hardware for basic kiosk operations are quite standardized, and their cost has been falling. Drishtee was able to get concessional terms for using the Windows operating system. Various local language software applications have been developed, for e-governance, market price information, buying and selling, and so on.

With the origins in Gyandoot playing a role, simple e-governance, such as making government forms available and allowing a variety of complaints to be relayed to the

district level government, has typically been the lead service in setting up operations in a new district. In this context, informal partnerships with district level government officials (both state and local) have been very significant. For example, in Sirsa and Jaipur districts, Drishtee has been able to act as a significant intermediary for information exchange between the district government and constituents. It obviously remains limited in its ability to improve the internal functioning of government. Nevertheless, Drishtee's approach can be viewed as achieving the right kind of 'embedded autonomy' at the local level, to use Peter Evans' term, meaning a societal structure with coherent institutions that are autonomous, but nevertheless connected through institutionalized channels for continual negotiation of goals and policies (Evans, 1995, p. 12).

Expanding the range of services has meant tying up with content partners, particularly organizations such as Agriwatch, which provides a substantial quantity and range of agricultural information to farmers. Agriwatch is essentially developing into a large-scale Internet portal for farmers, and Drishtee's role can be seen as providing last-mile access to this rich information, through its kiosks. It is difficult to quantify the benefits of this service, but its popularity with farmers suggests that it is valuable. Related examples from the cases of ITC and n-Logue will provide a more definite assessment of these benefits.

Drishtee's pricing scheme for e-governance services follows a set model. The full cost of a transaction such as obtaining, filling out and submitting a government form is estimated, including imputing the value of time spent in travel. The kiosk owner's fee for this is then set at about 10 percent of the estimated transaction cost, also taking into account possible willingness-to-pay considerations in choosing "pricing points" such as

Rs. 5, 10 or 20. Assuming that these fees can cover the full cost of the kiosk owner and Drishtee (which depends largely on generating sufficient volume) the saving in transaction costs is substantial. The savings in such cases are generated by reductions in travel and time costs. There may also be benefits in terms of improving the effectiveness of transactions (e.g., if a complaint through this channel s more likely to be addressed), but these are harder to quantify.

In the case of other services, such as matching buyers and sellers, or providing horoscopes or matrimonial advertising, additional services require partners who can provide software, maintenance, content or other components of the complete service. Education has played a limited role in Drishtee's offerings, though kiosk owners have often used the presence of a computer and peripherals to offer computer training, as well as other offline services such as printing and games. The benefits in these examples are reductions in transaction costs for existing transactions, improved quality of successful matches, and potentially most significant, completion of activities (e.g., training, entertainment, communications) that would otherwise not take place because of high transaction costs.

Finally, Drishtee has appeared to learn rapidly with respect to the selection and training of kiosk owners, and eliciting the preferences of rural Internet kiosk users. This partly reflects the organization's own structure and character. As a lean start-up, it seems to have attracted people who are relatively in tune with rural market environments. The process has not been painless, and there are still challenges in managing operations that are spread across several states, but Drishtee's ability to manage its own human resources and the end users of its services has grown over time.

In sum, Drishtee has emerged as a typical start-up. Without very substantial financial resources, it has still managed to expand, and it has built an organization with strong competencies in what may be broadly termed 'rural IT-based service delivery.' This judgment holds despite Drishtee's lack of any clear strength in technology, applications, partnerships or ability to scale. In all these dimensions, it is 'good enough,' but it appears to have built a strong, low-cost organization from scratch, one that may be well suited to delivering at least some components of the overall service. This competence is discussed further in the context of Aksh, a former Drishtee partner.

Aksh

Aksh is essentially a fiber optic cable company, with its core competence in laying and maintaining cable. Its revenue model is driven by the content and data that can be delivered over this cable. Therefore it has an interest in increasing such content delivery. While urban areas in India have seen substantial penetration of cable TV, through a model (now in transition) of largely unregulated local operators, the rural market remains largely unserved. The bottleneck has been the lack of last mile infrastructure, since there is a significant percentage of rural households (especially in richer districts) that can afford cable TV. Aksh, along with other companies such as Reliance, has received licenses for laying a new fiber optic network in rural areas.

In the case in point, Aksh rapidly laid a large fiber optic network in rural Jaipur district (excluding the city itself). It initially partnered with Drishtee for the development and maintenance of kiosks that would act as distribution points for cable TV access, as well as Internet kiosks. The Drishtee franchise model, interface and services were

adopted, but with the brand name of "Gramdoot." Aksh therefore appeared in the value chain as the provider of connectivity, with Drishtee handling all the other value chain stages illustrated in Figure 2. However, this asymmetry between Drishtee and Aksh was fairly quickly reversed, and now Aksh stands as the main service provider, with Drishtee reduced to the role of providing software and related services.

There are several reasons for this shift in the business relationship. Most obviously, Aksh's far greater size, resources and hardware capabilities give it an advantage in setting up and maintaining the hardware aspects of the kiosks. The rapid expansion of kiosks in Jaipur, with over 100 being set up within six months, stretched Drishtee's human resources beyond their limits. It was also not feasible to hire and train large numbers of people for servicing the kiosks. Second, the needs of the cable TV business, and some degree of competition that emerged with another cable TV provider in the same district created additional problems of maintenance (e.g., Aksh's cables were cut by the competitor) and conflicts in terms of priorities for bringing Internet-based services online – essentially, Internet services were the tail of the cable TV dog. Finally, Aksh's incentive was to control and brand the effort to score points for corporate social responsibility.

In any case, the model of rural IT-kiosks managed by a large company with incentives to provide access to large numbers of rural households appears to be scalable and sustainable. Cable TV over fiber optic networks provides a strong revenue base, and a range of Internet-based services and content can be provided through partnerships. As companies such as Drishtee also scale up, they may be more effective in providing the necessary scale for ongoing management of the kiosks, including training services and

customer relationship management. For now, providing software is easier for start-ups in such cases.

The history of Aksh's initiative means that the range of services provided in their kiosks, the revenue model, and pricing structures currently follow the Drishtee model. Hence the earlier discussion of benefits transfers over to this case. The importance of cable TV revenues, however, suggests that these kiosks may emphasize a range of entertainment services more than utility services such as agriculture-related information or e-governance. It is conceivable, however, that kiosk operators will be able to span the entire range of services. The bandwidth available will certainly support a full range of offerings, and the issues will be managerial attention and the perceptions of rural users. One important implication of greater bandwidth is that video interactions are possible, and Drishtee and Aksh have been able to test several communication services based on this. The power of video over text is in increasing the richness of information exchange, as well as greatly increasing the attractiveness and acceptance of all the services offered by the kiosks.

n-Logue

While Aksh and Drishtee are mostly active in north India, n-Logue has its origin and chief presence in the south. It is a for-profit corporation, with majority ownership residing with a nonprofit organization. The main impetus for n-Logue came from the IIT Chennai research group headed by professor Ashok Jhunjhunwala. This group has been responsible for a stream of hardware and software innovations that enable rural IT-based service delivery, through connectivity and applications.

The core innovation at the heart of n-Logue's operations is a WLL technology, Cordect, which provides joint wireless Internet and voice connectivity. The kiosk-level hardware is relatively inexpensive, and adds only marginally to the overall cost of a kiosk. However, the construction of WLL towers and maintenance of the WLL hub is relatively costly, and this fixed cost requires a substantial density of kiosks within a particular radius of the tower. The n-Logue model is designed to achieve this density, with kiosks generating returns from fairly small user populations (somewhat smaller than in the case of Drishtee and Aksh). Another constraint on this connectivity model is the requirement of clear lines of sight, and therefore relatively flat topography. Nevertheless, large parts of India are still suitable for this implementation. Furthermore, n-Logue has progressed well beyond being simply a connectivity provider, to delivering a range of services – these can be adapted to different connectivity technologies. N-Logue is the second largest organization in this field, supporting over 500 rural-IT kiosks.

The WLL technology does provide several strengths. It overcomes lack of dial-up connectivity, and provides an extra revenue stream for kiosk operators, through voice calls. Furthermore, it has greater bandwidth than traditional fixed line dial-up, which allows a wide range of applications to be delivered. In particular, the IIT Chennai group has been able to develop video applications that are sufficiently compressed to work within the constraints of the WLL.

In general, the close links with the IIT Chennai group have given n-Logue access to a range of software innovations for delivery and implementation of various applications in the fields of education, health and agriculture. For example, web cams have been used for remote diagnostics for diseases of people, animals and plants. A

considerable amount of local language software has been created quite rapidly and effectively. The university connection is important, and stands out as a model for other providers to emulate.

N-Logue has also been able to leverage its university connections to build strong partnerships across the board. The Tamil Nadu government has been strongly supportive of n-Logue's operations in Madurai district, where numerous innovations have been piloted and showcased. MIT's Media Lab has also been involved in the initial stages, and ICICI Bank is piloting various financial services products in kiosks in Madurai. IN Nellikuppam district, n-Logue has partnered with EID-Parry to improve sugar farmers' access to information, and reduce their transactions costs in dealing with Parry's large sugar factory in the district, through improved tracking and settlements of payments. In this case, the factory chimney has also served as a base for the tower, and the control hub is housed in the factory, substantially reducing fixed costs. Parry plans to use those kiosks that are under its own brand (several dozen in total) to offer processed foods to farmers.

N-Logue also appears to have developed a very capable organization, and has expanded beyond Tamil Nadu into other southern states, as well as the west and north of India. One advantage that emerged in discussions was the relative ease of establishing organizational capabilities, training kiosk operators, and serving rural communities in the south relative to the north of India. This reflects higher proportions of the population with basic education, greater population densities, and, in general, a more structured and stable civil society. A factor that seemed to emerge in all cases was the greater average success of women kiosk operators, possibly reflecting the fact that there is greater untapped

potential for rural women, given their otherwise more restricted employment opportunities.

Overall, n-Logue has several strengths compared to Drishtee, in terms of access technology, software applications and partnerships. Nevertheless, the two organizations are quite similar in terms of the range of services offered, and their ability to deliver close to an 'end-to-end' solution. Their social goals are more salient than those of Aksh, and each has achieved a substantial geographic reach and partnership capability. There are some differences in emphasis in terms of applications, services, and revenue models (Drishtee relies more on overall revenue sharing, whereas n-Logue charges mainly for connectivity). In each case, however, there has been a demonstration that rural IT-based services are commercially feasible, and as a corollary, provide quantifiable economic benefits. Since estimates of the overall market size suggest that it can support at least 50,000 kiosks (roughly one per 10,000 people), and these two organizations, plus Aksh, have less than 1,000 kiosks, there appears to be substantial room for further growth.

ITC

ITC stands out as a large Indian corporation serving global markets. Its kiosks are called e-choupals, and they have several differentiating features. The key distinguishing factor is that the e-choupals are totally designed to support ITC's agricultural products supply chain. This gives them a focus that is not present even in EID-Parry's kiosks in Nellikuppam. In addition, the e-choupals are totally owned and set up by ITC, with the operators not having any investment or risk of their own. Furthermore, e-choupal

operators are, because of the focus, always substantial farmers, and therefore always male. All these features make the e-choupals different from the previous three initiatives.

The e-choupal initiative has involved a clear focus and strong direction from the head of ITC's International Business Division. ITC has been able to turn its substantial organizational and managerial capabilities toward this initiative. Management trainees are heavily immersed in the e-choupal model as part of their inculcation into ITC's workings. There are four kinds of e-choupals, tailored very specifically for four different products: shrimp, coffee, wheat and soybeans. The first two of these involve large commercial farmers, and the focus is on creating Internet access to global market information to guide production and supply decisions. There are a few dozen of these e-choupals. In the case of wheat and soybeans, there are many small farmers, and over 2,000 e-choupals have been set up, in several states of India.

The description here is based on soy-choupals. Wheat-choupals are somewhat similar, with the final market and products being somewhat different. Soybeans are pressed to extract oil, which is sold domestically, while the remainder is exported as animal feed. Thus they are a cash crop, without the regulated market conditions or subsistence consumption associated with a food grain such as wheat. Soy-choupals are used as registry points for procurement of soybeans. Actual procurement is done at factories and warehouse hubs, but the initial logging in is done through the e-choupal, which provides price information and therefore price certainty. In fact, the e-choupal price acts as a floor price for procurement – the factory or warehouse price can be higher. E-choupals also provide access to local market (*mandi*) prices and global market price information on soybeans and derivative products, to allow farmers to compare prices.

They give access to operational information, developed by ITC experts, pertaining to cropping, seeds, fertilizer, and so on.

E-choupals are set up by ITC, with solar power backup and VSAT connectivity. The equipment cost for the e-choupal is borne by ITC, with the selected farmer providing the location. In addition to the adoption advantages that come from using a farmer with high social status as the operator, the house should be spacious and sturdy enough to house all the required equipment, including the VSAT and solar panel on the roof. E-choupal farmers take an oath to serve the village, and they are trained by ITC. While there is an important element of social pressure and pride of work, the operators also receive commissions on soybean shipments booked through the e-choupals. This provides substantial revenue to the e-choupal operator.

The narrow (at least initial) focus of the e-choupals and the substantial commitment of financial and human resources by ITC has made rapid expansion possible, as well as quick acceptance by farmers. The narrow range of applications has limited software requirements, and operators bear no risk in the ITC model. The longer-term goal is, however, to use e-choupals and warehouse hubs as sales points for soybean oil, tractor rentals, and eventually a range of ITC-produced consumer goods.

The initial benefits of the ITC effort include a substantial reduction in transaction costs, from 8 percent of a transaction, down to 2 percent, approximately. It is estimated that these gains are shared roughly equally between ITC and individual farmers. Some of this gain may be at the expense of traditional intermediaries, who operate in *mandis*, but much of it comes from genuine efficiency gains, including clearer quality guidelines and measurement, greater timeliness and reduced waits, quicker payments, and reduced

uncertainties. To some extent, traditional intermediaries are co-opted in the new process, by being hired to perform tasks such as handling payments at ITC's receiving points.

Clearly the use of information technology is just a part of ITC's overhaul of its supply chain, but speedy delivery of complex information pertaining to market conditions makes IT essential. It might be asked what acts as a check on ITC's market power in this process. Clearly, the traditional *mandi* system, with its accompanying government regulation and oversight, acts as continuing competition. More significantly, ITC's concern with its reputation acts as a disciplining device. Finally, the long term goal of selling back to farmers as customers also gives ITC an incentive to cultivate relationships with individual farmers. In fact, farmers view ITC as treating with greater respect and dignity than is the case in traditional *mandi* interactions.

It is quite conceivable that the ITC model will not broaden significantly beyond the two-way flow of agricultural produce from farmers to ITC, and processed foods, consumer goods and inputs from ITC to farmers, without extending to e-governance, entertainment, health or education-related services. Instead, other firms may provide these services in similar locations to ITC e-choupals.

TARAhaat

TARAhaat has evolved in a somewhat unusual manner. It achieved well-publicized success with Internet kiosks in Bundelkhand in Uttar Pradesh. These kiosks were very much along the lines of those implemented by Drishtee and n-Logue, with a mix of e-governance services, market price information, and so on. TARAhaat's long-range plans include a comprehensive portal for rural information services and an

extended vision of its 'TARAkendras' as community centers. However, in its expansion into Punjab, at the invitation of the administrator of Bathinda district, its model evolved quite differently.

While the Bundelkhand model had used VSAT connectivity, this was not economical for a commercially sustainable expansion. While Punjab is a high-income state with relatively good infrastructure, the level of telephone connectivity turned out to be too poor for practical Internet use. Other issues arose with the substantially greater investment required by TARAkendra operators, since the model assumed that each kiosk with have three or four computers. Perhaps the greatest problem was in building an organization for implementation. While TARAhaat is a subsidiary of Development Alternatives, an established NGO, it is set up as a corporation, with social goals meant to be enforced through ownership by the nonprofit parent. The expansion of TARAhaat required building an organization from scratch, and this turned out to be a slow process. There were also problems with establishing effective partnerships with local and state government, and TARAhaat has mostly gone it alone.

TARAhaat does have an educational content partner, called TARAgyan. In association with various partners, TARAgyan is developing local language content and software for use in TARAkendras. Basic IT education is an important part of TARAgyan's actual and potential offerings, but it is not the exclusive focus. In fact, there has been a substantial diversification into developing materials for English language instruction, rural marketing, personality development, and so on. This development was initially very slow, though it may be picking up steam.

The constraints faced by TARAhaat pushed its Punjab effort in the direction of locating in *mandi* towns rather than villages, and focusing on offering offline education rather than a full array of IT- and Internet-based services. Thus, the few dozen TARAkendras in Punjab have emerged as quite distinct from the Internet kiosks of the other organizations discussed in this paper. It is conceivable that TARAhaat will end up occupying a very distinct niche in small town India, quite different from a direct impact on the rural, agricultural part of the country.

Interestingly, Punjab may have been the wrong place to try to create efficiency improvements in agriculture, since there are relatively strong market and related institutions for existing crops such as wheat, rice, cotton and sugar cane. Efficiency gains in Punjab agriculture are more likely to come about through the intervention of the government to create a new infrastructure to support alternative, higher value-added crops, or through concerted efforts by large agribusiness firms such as ITC.

5. Conclusions

This paper has briefly surveyed several initiatives to provide IT-based services in rural India. I have provided a broad overview of the economic impacts of IT, and gone on to examine demand side and supply side issues of successful implementation. In particular, I have suggested that there is a broad range of services that can be provided to a cross-section of rural households, even at relatively low levels of income. This creates challenges for implementation by posing choices for organizations, but also opportunities for creating niches. I have also provided a framework in terms of the supply side value

chain, and used this to discuss the implementation of rural IT-based initiatives by several organizations.

All the organizations discussed in the paper face common issues of implementation, but differ in terms of how they have been handled. There are differences in scale, connectivity technologies, services offered, revenue models, organizational structures, and so on. Clearly, focused efforts with substantial financial and organizational backing have a good chance of success. However, even startups that have put together the required competencies and resources through partnerships and slow organization building appear to have room in this market.

There appears to be enough evidence now that it is commercially feasible to use IT to deliver services to rural populations either at costs that are lower than previous delivery methods, or in ways that make it possible to achieve delivery where none was earlier cost effective or feasible. Initially, the static savings from reductions in transaction costs may be of the order of a few percent of value added. However, the benefits from enabling new transactions should be an order of magnitude greater. In the long run, bringing rich information to the population of rural India, whether in the form of education, market prices, market opportunities, and more, can only have positive impacts on the material well being of rural masses.

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Endnotes

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[1] See Singh (2002) for a broader discussion of the potential role of IT in India's development.

[2] There is a growing literature on this topic: see Kaushik and Singh (2004) for references.

[3] In India, these include Bhoomi in Karnataka, e-seva in Andhra Pradesh, Lokmitra in Rajasthan, and the CHOICE Project in Chattisgarh. See also Bhatnagar and Schware (2000) for further examples.

[4] In some cases, government officials themselves illegally take on these intermediary roles, demanding 'speed money' or other payments.

[5] It is important to reemphasize that the following is a subjective assessment, and does not reflect the views of any of the individuals or the organizations they represent.