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Shivraj Kanungo  
*George Washington University*

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# ON THE SUSTAINABILITY OF RURAL INFORMATION SYSTEMS: ANALYSIS OF PRELIMINARY EXPERIMENTAL EVIDENCE

**Shivraj Kanungo**

Department of Management Science

George Washington University

[kanungo@gwu.edu](mailto:kanungo@gwu.edu)

## Abstract

*The use of information technology in rural settings is receiving increasing attention because of the immense potential it brings for improving the quality of life and reducing the digital divide. However, high costs coupled with infrastructure and context-related factors tend to dilute the advantages that are often taken as a set of givens. In this paper, we present a case study of a pioneering experience of IT use in a set of villages in southern India. The project was conceptualized and implemented by the M. S. Swaminathan Research Foundation (MSSRF) to assess the impact of modern information and communication technologies on sustainable rural development in the Pondicherry region of India. The essence of the challenge in this project lay in “reaching the unreached” by attempting to deliver the benefits of new technologies to the economically and socially disadvantaged sections of the rural population. This was conceptualized as a prerequisite for promoting a new paradigm of rural development based on concurrent and integrated attention to the imperatives of ecology, economics, employment, and equity. The system is called the knowledge system for sustainable food security. The long-term experiment is in progress and results presented are intermediate yet useful. Results of the study indicate that information technology when used in concert with an array of initiatives does indeed lead to manifest benefits. Moreover, many of the issues that are relevant to IT use in the corporate world are applicable—but need a different treatment. In essence this paper is an invitation to expand the horizons of mainstream IS research to include rural settings.*

**Keywords:** Information system, emancipation, sustainability.

## INTRODUCTION

This paper addresses the application of IT in a rural setting in India as a part of the information villages research project (IVRP). The project is set in the Pondicherry district that borders the southern State of Tamil Nadu. Most of the villagers are farmers or fishermen and many live below the poverty line. The IVRP was conceptualized as a part of a larger initiative called the “biovillage” project. Although corporate entities represent a small percentage of the potential user base in the world, almost all the attention in IS research has been paid to IS use and development in corporate organizational settings. So far, experiences from a largely rural and poor setting are rare. Data and ideas in this paper provide us with insights that could form useful inputs to bridge the digital divide. We have depended on documented information as well as data that were obtained directly from the project site through observation. While this study attempts to respond to the principal research question—how do we build effective information systems in a rural setting that are premised on emancipation?—there are interesting conceptual threads that intertwine with that question. Those questions allow us to foray into diverse analytical domains. To that extent, we have followed methods that most closely resemble frameworks provided by Klein and Myers (1999), Lyytinen (1992), and Hirschheim and Klein (1989). Our account is organized as follows. The next section provides the setting for the information villages. We describe our research method in response to our research objective and the research context. Project results are then described. The results are analyzed and conclusions presented in the final section.

## THE SETTING FOR INFORMATION VILLAGES

The biovillage development model (which was initiated in 1991 and of which IVRP is a part) is essentially people-centered, with a pro-nature, pro-poor, pro-women, and pro-jobs orientation, conceptualized through (1) the integration of the best in traditional wisdom and technologies with the best in modern biological technologies; (2) the pursuit of a holistic system for use and management of resources; and (3) enabling the resource poor to translate their skills into production and income generating activities through providing access to capital and support services, as well as by fostering group action.

Only 12 public and 27 private telephones exist in the project area, covering 19 villages with a population of 22,000 (three of them do not work). Of the 1,130 television sets in this area, a third of them have cable connection. The cable provides three channels, all in the Tamil language, produced from the city of Chennai.

In the initial phase, five villages had an *information shop* (also called a village knowledge center). Volunteers who are educated unemployed/school teachers/students/women of the village manage these “shops.” These managers of information shops act as information seekers for the village and satisfy the information demands of the village. Modeled along the lines of *pan shops*,<sup>1</sup> information shops convey the idea of villagers going down to the shop to purchase information. In the information villages, both traditional (like folk media, demonstrations) and recent (computer-aided extension, space applications) information technologies are blended in a suitable manner. The ultimate test of the success of this program depends on its impact on maximizing farm management efficiency at the production and post-harvest phases, as reflected by a reduction in expenditure and improvement in net farm income. Information seekers obtain what they need from among a set of information resource centers using an appropriate communication medium. In order to meet the various information needs of the villagers, the concept of a resource center was used. The resource center essentially acts as a single-point source for all types of information products. The information resource center is fed by a set of information producers. The specific content of the information package is determined by the needs and requirements of the villagers. The information needs of the villages were identified using the participatory rural appraisal methodology.<sup>2</sup> The nature of the information package as well as mode of communication varies from region to region. Major information producers or actors in the information system are shown in Table 1.

**Table 1. Information Producers on the Network**

- |    |   |
|----|---|
| 1. | Farm men and women                        |
| 2. | Remote sensing and meteorological centers |
| 3. | National information centers              |
| 4. | Research laboratories and universities    |
| 5. | Industries                                |
| 6. | Government departments and institutions   |
| 7. | Non-governmental organizations            |
| 8. | Financial institutions and markets        |

Given this context for the information villages, our research objective was to determine the extent to which existing theories in MIS are relevant to the emancipatory and inter-organizational nature of information systems.

## METHODOLOGY

This research was conceptualized as a case study. From an operational standpoint, we depended on Hirschheim and Klein (1989, 1994) to provide the analytical basis for focusing on the emancipatory function of information systems. In using the conceptual

<sup>1</sup>A *pan shop* is a kiosk that is managed by an individual. This kiosk sells betel leaves, nuts, tea, and other condiments in addition to small items that do not require a lot of investment. It is a common sight and in rural India, as well as in large parts of semi-urban and urban India, serves as a convenience store.

<sup>2</sup>PRA is a way of enabling local (rural and urban) people to analyze their living conditions, to share the outcomes, and to plan the activities. It fosters “handing over the stick to the insider” in methods and action. The outsider’s role is that of a catalyst, a facilitator and a convener of processes within a community, which is prepared to alter their situation.

framework provided by Hirschheim and Klein, we are also responding to an empirical gap they identify when they state, “virtually no published examples exist of how neohumanist values have been implemented in practice” (Hirschheim and Klein 1994).

Most interpretive and context-specific studies have focused on the uniqueness of the setting or the inappropriateness of applying theories developed elsewhere to highlight specific insights. What emerged during this study was the realization that there are many theories that are applicable as opposed to those that are not. In other words, there are many issues that are common and beyond context. Consequently, we encouraged ourselves to look for generalizations much in the spirit of the principle of larger explanatory frameworks subsuming specific theories. This approach is in consonance with the principle of dialogical reasoning where the “researcher confronts his/her preconceptions (prejudices) that guided the original research design (i.e., the original lenses) with the data that emerge through the research process” (Klein and Myers 1999, pg. 75).

Apart from a brief historical reconstruction to establish empathy with the protagonists in the study (Mason et al. 1997), this study was based on a series of intensive interactions with the project staff and information village volunteers. Limited direct interaction took place with users. While in-depth interviews formed the major source of data, additional documentary evidence was based on project plans and reports, interim studies, and related documents. We also benefited from numerous articles from the popular press.

Our approach was to collect rich data and relate that to existing theories in the domains of IS development, IS use, and IS management. In our quest to map theory to practice, we found ourselves alternating between the functionalist and the neohumanist quadrants (Hirschheim and Klein 1989). To obtain an integrative perspective, the neohumanist framework allowed us to be inclusive enough to incorporate and discuss narrower theoretical frameworks.

## A REVIEW OF PRELIMINARY RESULTS

Each shop differs in its operations and how it is supported. In Kizhur, with an active Village Development Council, volunteers were chosen by the general body of the Council, which also nominated a 23-member (14 men and nine women) group to guide the shop’s operations. The volunteers, a woman and a man, belong to the elected family, which has set aside a portion of their house for the shop. They both have had schooling for 10 years, and have been given training in the basic operation of a PC running WIN95, including handling e-mail, and have been exposed to the use of HTML.

All of the volunteers at the shop in Embalam are women in the age group 21 to 27. Each of them spends half of a day at the shop and they take turns to attend work. The shop is located in the premises of the village temple that is owned by the community through a non-formal trust. The trustees convened the general body meeting to allot space for the shop and provide electricity. The trust has made these available, and signed an memorandum of understanding with the MSSRF for hosting the shop. In addition to e-mailed bulletins, this shop also receives RealAudio files containing the same information to facilitate its use by non-literate women.

Veerampattinam is a coastal village with a large population, 98% of the families being fisher families. Illiteracy among women is high. This village has its own *panchayat* (elected body). The *panchayat* has allotted space in its own office for the knowledge center. Three volunteers, two women and one man, have been identified by the *panchayat*, and they have been given training in handling PCs and data communication. This center now receives data on fish aggregation off the coast of Tamil Nadu and Pondicherry from the National Remote Sensing Agency (NRSA).

The shops are normally open on all working days from 0900 to 1800 hours without a break. An analysis of the user profile in Embalam revealed that, in Embalam village, nearly 50% of the users were women, whereas this proportion was less than 20% in the other village. Separate group meetings with the women were held where it emerged that most women with infections or disorders in the reproductive system prefer the PC in the information shop as the best means to access information on preventive/ remedial measures. A workshop was organized for them with the senior specialists in the Jawaharlal Nehru Institute for Medical Education and Research (JIPMER), an institute of advanced study located in Pondicherry, and the experts are now in the process of creating content that can be presented as non-linear, interactive slide collections.

Positive impacts on project goals (that can be attributed to the information system) have been documented and reported by project participants:

- In Embalam, a group of 48 women, all from the assetless labor families, have insured themselves against accidental loss of life or limb. This first-ever purchase of insurance policies was the result of value-added information provided by the shops.

- A farmer holding a plot of two acres started cultivating a hybrid variety of paddy for the first time in six years because he obtained information on the price of seeds and its availability from the shop at the right time. Two more farmers were also enabled to cultivate the better hybrid variety of paddy.
- Sundari, a women laborer in Embalam, was able to negotiate better with a landed proprietor for wages. Part of her wage is paid in kind in grain. Knowledge of grain prices in the neighboring markets enabled her to ensure that she received the right quantity of grain as wage. In the past, she had to go along with whatever price the land proprietor fixed.
- Lakshmi, a field laborer in Kizhur, who had always been looking for additional income-earning opportunities, identified a government sponsored program that provided credit and training for the manufacture of incense sticks with the data available in the shop. She received credit and training and now supplies incense sticks to a retail shop in Pondicherry.
- Jayakrishnan, a volunteer at Kizhur, mentions that a number of users who needed to spend an hour commuting to the nearby sugar refinery to get information on input (fertilizer) availability have been able to save effort and time by placing phone calls to the factory managers.
- Fourteen farmers in Kizhur have had their sugarcane crops ravaged in two years (1997 and 1998) by "Red rot" disease, resulting in unbearable losses. In the subsequent year (1999), prior to start of planting, they established contact through the shop with an entomologist who prescribed easy-to-implement preventive measures.

Perceptions, followed by the experience, of such benefits have led the existing users to request additional information on animal husbandry. In one of the villages, the community has resolved to create an economic support system for the information shop by assigning 9% of the revenues accrued from the sale of tamarind fruits on the common land.

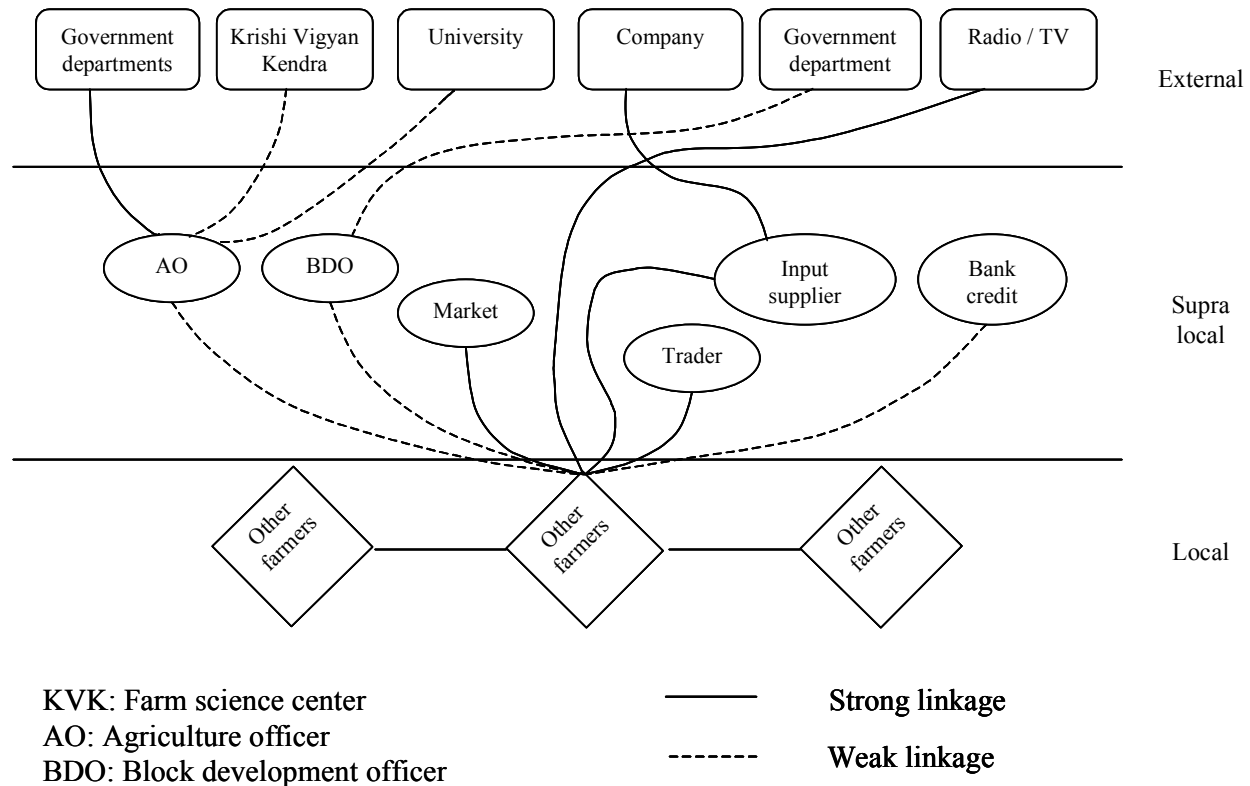
Benefits due to the information system can be mapped on to the entire spectrum of action types outlined by Habermas (1984). However, the more valued outcomes (those that are emancipatory in nature) are largely a result of communicative or discursive actions on the part of actors. It is evident that purposive-rational action types tend to be necessary to realize the emancipatory function in information systems. For instance, the lady who was able to bargain better with the landlord experienced not only economic benefits but also social empowerment as a result of the move toward an ideal speech situation (Habermas 1984).

## **ANALYSIS**

The information village project can be described as an inter-organizational system. However, the linkages between organizations are tenuous and can be traced only by the degree and nature of interactions between individuals in these organizations. In order to analyze the effectiveness of this information system, we need to understand and analyze the specifics related to development, use, and management of this information system.

## **System Development**

There is evidence to suggest that generally accepted frameworks in system development are applicable in this setting also. User participation, built into the larger biovillage project, not only helped identify information requirements, it also helped eventual system use. The incorporation of PRA allowed the information village project to respond to all four aspects of participation in the ETHICS framework: structure, content, process and obstacles (Hirschheim and Klein 1994). Lee and Leifer (1992) have provided evidence that information sharing is a key concept for linking organizational structures with IS structures. Such links were derived through an intensive information mapping exercise (see Figure 1) carried out by the stakeholders collectively before the project was implemented. This exercise revealed that the majority of the communication and information interaction took place in the supra-locality. However, the agency theory as it works in corporate MIS settings (Huarng 1995) is not applicable because end users of information are not necessarily the end users of the computer systems (who also create, and add value to existing, content). In such settings, the originator of the idea (in this case MSSRF) has to take a leading role in the development of systems with the explicit understanding that its role has to diminish in the future in the interest of sustainability. This is different from the corporate world, where the developer of the system tends to look forward to a long-term strategic partnership with all stakeholders of the inter-organizational system.



**Figure 1. Information Linkages as Analyzed from the Farmers' Standpoint (Balaji et al. 1999)**

## System Use

Multiple theories have been used in MIS literature to understand user behavior. One of the most used behavioral theories is the theory of reasoned action (TRA) (Fishbein and Ajzen 1980). Variants of TRA include technology acceptance model (TAM) (Davis et al. 1989). However, all of these theories are premised on the assumption that the user of the information is the user of the computer system. Consequently, there is no way to evaluate whether these theories are indeed applicable to end users in this context. However, this situation presents us with a nature of computer use that may prevail for some time to come. This can be described as human-mediated computer use. Those who manage the shops in villages post printouts and write the relevant information on chalkboards. They also help information seekers to listen to voice or view video files. While the move in developed country settings is to use the information system as a medium for collaboration, the resource crunch in rural settings in developing countries gives rise to collaborative mechanisms that become a prerequisite for meaningful use. Many villagers use three to four computers mediated by three to four computer users. This gives rise to situations that lend themselves to deeper analysis since “when people communicate, they do not send messages as electronically linked senders and receivers. They perform social acts in action situations that are normatively regulated by, and already have meaning within, the organizational context (Ngwenyama and Lee 1997, pg. 164). In many ways IT use is fostering what is primarily an oral culture in rural India. Since there are many end users of information who do not know how to read or write, natural language capabilities and voice and video capabilities allow users to create and receive messages that do not require them to touch a keyboard. This does require intermediation by operators in the shop but the IS use reduces unwanted intermediation by traders and middlemen. Kumar et al. (1998), analyzing the experience of a similar experiment in Prato, write “the third rationality, instead of focusing on political conflict and power plays as the primary interaction mode, focuses on collaboration and cooperation as the key interaction processes” (pg. 221). While we agree with Kumar et al., we found that IS theories need to treat both (equally) because, in our case, the notion of collaboration among villagers and between villages arose, among other things, as a reaction to the concentration of power or the inefficiencies of middlemen and government services. Additionally, it is not yet clear how the concentration of power in the hands of a few computer operators in the shops is going to play out. The presence of a flexible and evolving evaluation and review system, which was one of the original project objectives, indicates the awareness of the project staff regarding the potential for “discursive processes” associated “validity claims” (Lytinen and Hirschheim, 1988).

## The Management of IS

The information village project does not have an owner *per se*. However, in order to be sustainable, some notion of collective ownership has to evolve. There are preliminary indications that in a federated mode, villagers in one village have started providing some economic support for the shop by apportioning a percentage of sales of tamarind toward the shop. However, the information system can only remain viable if shops in all villages remain sustainable and information generation, use, and interchange keeps on taking place.

As of now, the principal catalyst in this entire process is the MSSRF with the villagers being aware that they own the shop. However, there are significant subsidies that have to be accounted for in the future. Sustainability arises as the critical success factor that will influence how information and information technology resources are managed in the post-experimental phase. The information village is need-based and community owned. Community ownership is important from two standpoints. First, since no individual will be able to sustain the upkeep of the information shop, a collective ownership framework helps sustain the initiative. Second, community ownership is a strategy to deconstruct existing assumptions that act as impediments to the larger project objectives. For instance, to share information, access is crucial. Community ownership implies access to everyone regardless of social status. Ezhil, a woman from Kihzur, is convinced that they have a sustainable future. She says “rural women, even those with high school education, are not treated with due courtesy, in families or in the community. Handling the PC gives us confidence and status, which we can not give up” (Raman, 2000).

In addition to qualitative results, the project has succeeded using the simplest but most powerful of TQM principles in that if you don’t measure, you don’t improve. Table 2 shows metrics associated with the project.

**Table 2. Village Knowledge Centers Metrics**

<b>Average working hours</b>	
Average working hours	9.1
Time	0900-1800
Average number of users	8.77/day
Closure (weekly)	Sundays
Closure (other occasions)	Local festival days
<b>Technology stability (January 1999–January 2000)</b>	
Number of PC breakdown calls	4
Number of printer breakdown calls	2
Wireless breakdown calls	6
<b>Analysis of users' registers/patterns (%)</b>	
Voice	
Personal	17.80
Program-related	2.96
Data	
Agriculture and fisheries	13.60
Education	20.15
Employment and training	2.58
Health	9.57
Government sector/entitlements	32.72

The project data collection framework represents the demonstrated elements of “heedful interrelation” (Weick and Roberts 1993) that point to a sense of collective failure or collective success. In this context, collective success implies livelihood and is, therefore, critical to survival. The villagers’ commitment and willingness to make the experiment a success resembles heedful performance. “In heedful performance, the agent is still learning. Furthermore, heedful performance is the outcome of training

and experience that weave together thinking, feeling, and willing” (Weick and Roberts 1993, pg. 362). Emergent behaviors and roles of participants in the information village project point to a collective mind that is focused on willful improvement of the quality of life.

This exemplifies two important characteristics of conceptualizing and deploying an information system from a neo-humanistic perspective. First, there are issues that are beyond methodology as exemplified by the heedful imperative described above. Second, notions of effectiveness and efficiency (technical issues) and mutual understanding (communicative issues) tend to be either precursors to, or coeval with, emancipatory outcomes.

## The Principle of Complementarity

We believe that the information village projects have helped distill and validate (albeit in a significantly different setting) the findings and results of prior work undertaken by Dewan and Kraemer (1998) and by Bresnahan et al. (2001). In addition, such cross-validation will allow us to utilize powerful general theories that exist across different settings.

The distinguishing feature of the IVRP was that it was based on the work initiated by the biovillage program. Significant groundwork and preparation went on before information technology was introduced. This program established the protocol for interacting with the villagers by operationalizing the PRA framework. The underlying beliefs and assumptions associated with the larger vision of being a human-centric concept led to a “new culture of working with the poor, one of providing them human dignity and not subsidies” (Krishnakumar 2000). By the time IT was introduced, the biovillages were well on their way to providing livelihood systems that include technical knowledge and skills. Such a build-up and requisite preparation for the IT infusion may, in large part, be responsible for the relative success of the information village. Support for this comes from Dewan and Kramer when they conclude that “the estimated returns from IT investment reflect other changes in the economies of developed countries that are complementary to IT investments such as infrastructure, human capital, and informatization of business processes” (pg. 62). Additional support for such requisite build-up comes from Bresnahan and Brynjolfsson, who use the phrase “complementary investment.” Since Bresnahan and Brynjolfsson offer a theory of causation that “more firms with skilled workers find computers more productive and buy more of them,” we have reason to believe that rural contexts that are better prepared to absorb information technology will be able to leverage the benefits of information technology. Brynjolfsson and Hitt (2000) provide an alternate explanation when they state “firms must incur substantial *adjustment costs* before IT is effective.” We believe that these adjustment costs may tend to be prohibitively high for rural contexts to absorb.

In cases of resource-challenged information systems, the role of intermediaries like the MSSRF is critical. Their role needs to be understood in terms of their value addition primarily in terms of knowledge creation and vision articulation so as to ensure viable processes that enable what may be termed as behavioral diversity of men and women who can now play newer and even concurrent roles as producers, innovators, and entrepreneurs. Just as bio-diversity is critical for sustainable agriculture, behavioral diversity is essential for the viability of the socially and ecologically reengineered village as a part of the global village experiment.<sup>3</sup> Throughout all this, just as we have enabling processes, intermediaries take on the role of process enablers. In assuming this role, organizations like MSSRF prevent what Berghel (2000) calls predatory disintermediation. In doing so, Internet-enabled benefits tend to be experienced while the exploitative potential is minimized.

One of the critical success factors for the success of the IVRP can be understood in terms of the “tuition paid for the learning” (Dewan and Kraemer 1998) that preceded the diffusion of IT in the villages. Figure 1 shows an artifact of that learning. It is an exemplar of the deep analysis and study that preceded the introduction of the information technology into the field.

## CONCLUSION

Initial lessons that we have learned are as follows. Systems development is not the major challenge. The major challenge lies in people development and development of a conceptual system—of knowledge networks or wisdom networks. Coexistence of traditional and modern technologies is crucial as evidenced by the multiple communication media. Modern communication technologies should support and bolster existing communication systems. Robust technology is crucial. Developing trust in such systems is equally important. Usually, such systems do not get a meaningful second chance. Trust has two components: trusting

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<sup>3</sup>From the standpoint of the law of requisite variety (LRV) (Ashby 1958), these can be understood as variety attenuating or amplifying frameworks (Beer 1973) that form the basis for questionnaires in the ETHICS methodology (Mumford 1983).



the technology and trusting the individual on the other side of technology. The barter of information is as important in rural frameworks as in urban ones. The information system should be embedded in a larger framework that addresses quality of life improvements. The developers and implementers of such systems should plan for and achieve immediate and long run outcomes.

Remaining challenges include how to evolve replicable models and identifying predictors of sustainability. Our experience reveals that technological problems are the lesser of two problem areas—the second one having to do with people, processes, and structures. Power structures change with the intervention of technology. A major challenge in the project has to do with achieving a delicate balance between deconstructing existing belief systems as gently as possible while empowering disadvantaged individuals or groups and working toward an equitable system of information use and benefits experienced. Technologically replicable systems have been achieved. Replicability is assured by using standardized and robust technologies. However, replicability of success experiences may not be possible since contexts differ and a high degree of serendipity has been experienced in villages that have many geographic and cultural similarities in addition to geographical proximity.

One general finding has implications for both practitioners and researchers. The Bio-village project as a precursor to the information village project can be considered, in hindsight, a complementary investment. This complementary investment was successful in amplifying the variety of the existing village system and, in conjunction with the IVRP, was able to successfully reduce the external variety. We believe that the law of requisite variety (LRV) (Ashby 1959) holds the promise of contributing significantly to practice as well as research by its ability to help conceptualize information systems as a resonating framework between any system (in our case the village) and its environment. Another application of the LRV (variety attenuation) is in terms of localizing globally available scientific knowledge to and applying those concepts in a locally sensitive manner.

Sustainable rural information systems, when envisaged from the viewpoint of “self-interest and ” that are “likely to create a win-lose view” of transactions (Kumar et al. 1998, pg. 221) appear to be a distant dream. However, as demonstrated by the information village project, the notion of “trust-based rationalism” (Kumar et al. 1998) provides a framework to conceptualize and actualize sustainable rural information systems that are severely resource challenged. Their sustainability derives from a higher value-driven perspective. This perspective is very closely tied in with the collaborative ideals. However, without the project support system, we do not believe that the information system would survive. Cost and technical expertise still present primary barriers to viability. There is evidence to suggest that most theories-in-use in IS do apply at higher levels of abstraction. However, multiple research approaches and additional studies are required to identify and fill gaps in knowledge associated with IS use in underprivileged settings. In particular, additional research is required to understand heedfulness in the creation and articulation of a rapidly emergent collective mind, diffused notions of ownership, and community governance structures. We hope that this experiment sparks the interest of IS researchers to investigate issues beyond corporate frontiers in areas that affect more than three-quarters of the world’s population—especially since the digital divide continues to grow (Arunachalam 1999).

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