Mobile Applications for the Next Billions: A Social Computing Application and a Perspective on Sustainability

Catalina Danis, Mark Bailey, Jim Christensen, Jason Ellis, Thomas Erickson, Robert Farrell, Wendy A. Kellogg
IBM T.J. Watson Research Center

Our focus is on designing and deploying mobile social computing systems for delivering actionable information to "next billions" users in a sustainable way. Given that people are fundamentally social, their use of information and communications technologies cannot be understood separately from social considerations. Our approach is to use social computing techniques, such as recommendations based on shared participation in a social network, to extend existing social practices in a community and increase the visibility of local knowledge. We introduce the Picture Talk infrastructure that enables us to build mobile, information-sharing applications, such as Rice Talk, that supplement voice interaction with visual scaffolding and social computing techniques.

Categories and Subject Descriptors: Categories and Subject Descriptors: H5.3 [**Information Interfaces and Presentation**]: Group and Organizational Interfaces – *Asynchronous interaction*; J.4 [**Social and Behavioral Sciences**]: Psychology; K.4.2 [**Computing Milieux**]: Computers and Society – Social Issues
General Terms: Design, Experimentation, Human Factors
Additional Key Words and Phrases: Human-computer interaction, User Interface, Computing in Developing Countries, Social Issues

---

1. INTRODUCTION

We are interested in designing mobile social computing systems for the next billion users.[1] Our aim is to create systems that are appropriate and appropriable within their social, cultural, infrastructural, economic, and political settings. We believe that these characteristics are critical for systems that will be sustainable in their environments. In this paper, we discuss our emerging work on mobile applications and the social computing approach that underlies it. We note the growing interest in applying ICT to transform the "digital divide" into the "digital provide." Addressing perceived gaps between people who lack access to digital information – heavily concentrated among poor people in developing nations – and those who do have access [Keniston 2002; Keniston & Kumar 2004; Srinivasan 2007], however, involves more than solving technical challenges surrounding wireless connectivity or electrical power.

---

[1] A variety of phrases to refer to people from sub-Saharan Africa, the Indian subcontinent and/or South/Central America who do not have regular access to the 'standard' platform of an Internet-connected desktop computer are in current use. These include the "next billion users," "next billions," and users at the "bottom of the pyramid" or "BoP." We use these terms interchangeably here.

A social computing perspective emphasizes the crucial nature of social, cultural, and other non-technological factors. It draws attention to people and their social practices as critical resources in designing successful information and communication systems [Ackerman, Halverson, Erickson, Kellogg 2008]. We take heart and inspiration from many emerging mobile applications in developing nations, and discuss how the framework of social computing can provide insight for the design of viable, sustainable applications targeting the next billion users.

2. SOCIAL FACTORS AND THE VALUE OF INFORMATION

"Information is power. Nowhere is the aphorism truer than in developing countries." [Abraham 2007]. So begins Abraham's analysis of the economic impact of mobile phones on fishermen in the southeastern Indian state of Kerala. Interestingly, his findings only partially support the "information is power" hypothesis. In Abraham's data, about 75% of the fishermen using mobile phones to get market price information before deciding where to sell their fish reported lower business risk, and 50% reported fewer losses due to unsold or spoiled fish. About 40% also reported an increase in income after adopting this practice. In spite of these gains, though, few reported consistently going to markets offering the highest prices; instead many chose ports where their "commission agent" had a presence. Commission agents are middlemen who invest in fishing boats in exchange for a cut of each catch; they are in a supply chain relationship with the fishermen. From an "information is power" perspective, the fishermen's behavior can be seen as somewhat disappointing – Abraham's analysis shows that the pricing information is reliable, so why do the fishermen fail to take full advantage of it? He concludes that social factors change the impact that market information has on behavior [Abraham 2007]. Because an agent cannot easily verify or collect his commission from a port in which he has no presence, he has an interest in having catches in which he has invested sold only in ports where he does. Because the agent has invested in his business, the fisherman feels a social obligation to bow to his wishes, even when doing so may prevent him from maximizing his income.

Narayan and Glinskaya [2007] also highlight the influence of social context on behavior in their introduction to a collection of case studies addressing poverty in Southeast Asia. In their summary of what contributes to successful projects, they identify four elements that can impact "institutional climate, power relations, and the incentives of actors engaged in unequal power relationships" [which, they argue, characterize the plight of many of the world's poor]. "[These] are: access to information, mechanisms of inclusion and participation, social accountability, and local organizational capacity.” [Narayan & Glinskaya 2007, p. 15] Note that all of these factors are frankly or arguably social in nature.

3. EMPIRICAL OBSERVATIONS FROM THE FIELD

A growing number of reports from the field, primarily studies of Indian farmers, illustrate specific ways that social factors affect the actionable value of information. For example, Srinivasan [2007] analyzes farmers’ use of web-connected kiosks (telecenters) fielded by the Parry sugar factory in the southern state of Tamil Nadu. Srinivasan compares mediated communication between strangers with face-to-face interactions between familiar interlocutors through the lens of an encapsulated interest model [Cook 2001, described in Srinivasan 2007]. In this model “trust exists when one party of the relation believes the other party has incentive to act in his or her interest” [Srinivasan 2007, p. 346]. For example, farmers seem to trust the Cane Sub-Inspectors (CSIs), who are employees of Parry, in matters regarding the treatment of diseased plants because they believe the CSIs share their own interest in producing a high yielding crop, but will not ask them to recommend which varieties of sugarcane to plant. Sugarcane varieties differ in time to maturity, with slower to mature varieties producing higher sugar content yield (of interest to Parry) and faster maturing plants attain higher crop weight (of interest to the farmer). The conflict of interest leads farmers to ask fellow farmers rather than CSIs for recommendations. Similarly, farmers will use the telecenter to only ask “simple” (i.e., low-stakes) questions of a purported agricultural expert who is not known to them, saving “high-stakes” questions for successful farmers with whom they have some pre-existing relationship.

Gopakumar [2006] argues that local people played a critical intermediary role in the success of telecenters that provided e-government services to the rural poor (e.g., information on agriculture, health and education, support for transactions between citizens and government). He argues that factors such as living in the same village led target users of the Akshaya telecenter, in the Indian state of Kerala, to develop trust in the entrepreneurs and intermediaries who ran the centers. By extension, they developed trust in the abstract systems of medicine and government that are the ultimate sources of the information. In another study, Kumar and colleagues [Kumar, Rajput, Agarwal, Chakraborty, Nanavati 2008] conducted interviews with consumers of “microbusiness” services such as carpentry and plumbing, which are part of the large informal sector of the Indian workforce And found that consumers locate such services largely by word-of-mouth. They found that the single greatest pain-point for consumers was "…the lack of accountability and quality of service guarantees that exist in these unorganized sectors." [Kumar, Rajput, Agarwal, Chakraborty, Nanavati 2008, p. 937].

To summarize, these studies demonstrate the power that access to information can have in improving people's lives, but also how the impact of information is gated by social factors like trust, accountability, and social and institutional pressures. The question we address in the remainder of this paper is how do we come to grips with these factors, especially in going about designing appropriate systems for the "next billion"?

4. THE SOCIAL COMPUTING PERSPECTIVE

An important focus for our work over the next decade, and for the global community, including the next billion users, is to create technologies, practices and solutions that will drive bottom-up solutions to the vexing problems of poverty, illiteracy and disease that are so widespread in developing countries.

We believe that social computing is uniquely well-suited to contribute to effective ICT applications for next billions populations, because of the great leverage it can provide on trust and other social issues. In this section we describe the social computing perspective and briefly review some of the techniques that have emerged over the last ten years. We then place the work in the context of discussions of sustainability.

Social computing makes the claim that people are fundamentally social; therefore their use of information and communication technologies cannot be understood separately from social considerations. This means that people access, evaluate, and consume information in a social context, such as the judgment in the CSI example as to whether an opinion expressed by an individual on a particular topic is trustworthy. Our perspective is that even when no ICT is involved, people through their social interactions are effectively making social 'computations' all the time – for example, collective judgments, recommendations, decisions, etc. The key for applying a social computing perspective to next billions' applications is to understand how to employ social computing techniques to enable social dynamics such as establishing norms, imitation, self-organization and empowerment around goals next billions users already have.

The set of social computing techniques is by now quite large with many proven examples. Common ones on the Internet include Amazon's book recommendations [Amazon] and eBay's buyer feedback rating system [Ebay]. The research roots of social computing can be traced to ideas presented in, for example, the Hill and colleagues' seminal paper on "edit wear" and "read wear" [Hill, Hollan, Wroblewski, MacCandless 1992], which was later elaborated in the concepts of "history enriched digital objects" and "social navigation" [ibid]. This body of work noted the utility in everyday life of traces of individuals' behavior and set out to implement similar affordances in the electronic medium. Hill and colleagues [ibid] designed "read wear" scroll bars that reflected how often a page in a document had been read – an analogue to a "well-thumbed book." Social navigation drew on the "well worn path" as a metaphor for providing electronic information traces of visits to information spaces.

Another focus of social computing techniques can be seen in the explosion of "social software" and "Web 2.0" mechanisms for aggregating and sharing social information. A wide variety of "architectures of participation" have emerged, from the crowd sourcing of product ratings, to maintaining personal relationships on social networking sites, to the viral spread of widgets, games, and more. These techniques often motivate use and draw people in (e.g., the recent "25 things" meme on Facebook). Some social computing interactions, for example, freerice.com, can be highly motivating. Blogs and wikis have created new ways to collect, share, and improve information through social contribution, extending pre-Web 2.0 forms of discussion (such as bulletin boards, newsgroups, forums) which lacked the openness of today's social applications [Rheingold 1993].

Social computing mechanisms play a valuable role in directing attention to, vetting and remembering valuable content on the web. From "karma points" on Slashdot [Slashdot], to automatically generated recommendations based on massive analysis of user posts, such as PHOAKS [Phoaks], to social bookmarking and tagging on sites like del.icio.us and Flicker, to the "friending" and "following" enabled through social networking sites such as Facebook [Facebook] and Twitter [Twitter], information on the net has become saturated with social information.

One further aspect of social computing that we believe will be useful for addressing the "next billions" space is the concept of social translucence [Erickson, Smith, Kellogg, Laff, Richards, Bradner 1999; Erickson, Kellogg 2000] that our group began developing over a decade ago. The fundamental claim of social translucence is that it is possible to design digital systems that support coherent behavior by making participants and their activities visible to one another. In socially translucent systems, three characteristics – visibility, (mutual) awareness, and accountability – enable people to draw upon social norms and experience to effectively organize their interactions with one another. The "translucence" of social translucence signals that visibility and its consequences structure interactions both through their presence and, just as important, their absence. That is, people carry on their actions and interactions with acute sensitivity to how visible their activities are and to whom: being able to take advantage of options to conduct interactions that are completely public, completely private, or in the large range of in-between or "translucent" states, is critical to supporting the social practices that pervade daily life. While social translucence comes 'for free' in the physical settings that undergird face-to-face interaction, it must be carefully and consciously designed into digital environments.

5. SUSTAINABILITY OF SYSTEMS

From its origin in the context of development that does not harm the environment [Research group on the Global Future 2009], the term "sustainability" has recently been applied to a set of concerns about the future viability of systems deployed in the developing world. These are often small-scale projects, many only prototypes, which are initially deployed by various "donor" groups and associated research groups. The concern is that once the research is completed or funding is depleted the system will no longer be maintained and will soon cease to provide value to the intended users [Moyo 2009; Prahalad 2005].

Several sources of threat to sustainability have been identified in the literature. With respect to donor funded systems, the threat is not only the lack of a self sustaining economic model for the system [ibid], but also from a lack of skills in the local ecosystem that would promote continuing, locally-aimed development [Gakuru & Tucker 2009]. Another possible threat to sustainability comes from systems designed without consideration of the cultural context of the intended users [Rankin, Thomas, Ndawe 2009].

A critical test for sustainability arises when attempts are made to scale up successful local prototypes to a regional or national level. Narayan and Glinskaya [2007] have compiled a series of case study reports on systems that have been successfully scaled up but note the difficulties in doing so, pointing out the importance of a committed champion. We believe that social computing techniques can help navigate this threat to sustainability by leveraging existing community relationships to encourage spread of use of a system and to reinforce "stickiness" among existing users. For example, capabilities like end user content creation can engender powerful feelings of inclusion and agency, which improves sustainability by creating a sense of ownership that encourages continued use and growth. Techniques like social networking, social bookmarking, reputation management, and rating provide mechanisms by which content can be navigated, shared, and managed by the community. In this way, we believe applying social computing here enables the development of solutions that meaningfully extend existing social practices.

The involvement of local institutions and local knowledge is also important for sustainability. Local governments, user associations, service organizations and other local institutions can procure and position resources and local knowledge, monitor and resolve problems, and engender an atmosphere of cooperation. Uthoff (1992) cites cases in Mexico, Nepal, and the Philippines where local institutions and knowledge were disregarded. Engineers were planning dams to improve irrigation, local people told the engineers that the location and/or design of the dam was wrong, but the experts placed more faith in their calculations and proceeded, only to be embarrassed when the dam washed away shortly after being built. One of the prospects social computing offers is to increase the visibility of local knowledge, and, by allowing others to add to and reinforce it, to amplify its legitimacy and impact.

In summary, many social computing techniques have been forged in the hothouse of Web 2.0 on the nearer side (to us) of the digital divide. Where these rely on assumptions and familiarity with the web and its ways, there will be gaps that must be bridged or circumvented in order to apply social computing in the "next billions" space. Nevertheless, where there are people, there are social practices and goals that good social computing design can enhance and support. There is already ample evidence that the next billions population is wasting no time creatively appropriating communications technologies to their own ends. We particularly like the example of *sente* in Uganda reported by Jan Chipchase [2006]: a city dweller buys a phone card, calls the village "phone lady" and gives her the code, who takes a small commission and delivers the rest of the value of the card in cash to a relative living in the village.

Ultimately, we may have as much to learn from emerging uses of technology in developing nations as we have to bring to the table in mobile technology offerings. To this end, we are both working to improve our understanding of the next billions through in-depth ethnographic work as well as building initial applications we aim to field test with such populations.

6. THE MOBILE WEB PLATFORM

Advances in cellular technology and the rapid penetration of cell phones in non-urban areas make them an attractive platform for reaching next billions populations, where reliable power and wired infrastructures cannot be assumed. While other approaches are being explored that depend on "desktop" models (e.g., thin clients, and the one laptop per child initiative [Uphoff 1992]), the proliferation of cell phones provides an alternative that can be used widely now to experiment and develop and test a repertoire of examples.

The UN's International Telecommunication Union reported worldwide penetration of cell phones to have reached 50% in 2008, representing a four-fold growth since 2001 [Rncos 2008]. In Africa wireless phone usage has leapfrogged landlines, with over 200 million subscriptions in 2008 compared with 10 million in 2004 [Hersman 2008]. Overall, 68% of the world's wireless subscriptions are in developing nations.

While a significant proportion of cell phones deployed in next billions countries are lower-function units (e.g., voice and text messaging but no camera or touch screen display), cost is expected to decrease significantly over the next five years. This means that future applications can be designed for deployment on something akin to current high-end phones. Such devices provide the computing capabilities of the personal computers of the mid-90s along with state-of-the art wireless connectivity. As such, these devices can leverage a wealth of social computing and Web 2.0 innovations. However, as noted, social computing did not primarily evolve in this space. Because social computing on the web developed on desktop and laptop computers, software developers could expect large populations of literate users with relatively large screens, and high bandwidth connections. That isn't the case here.

7. THE "PICTURE TALK" INFRASTRUCTURE

Our work over the past year has focused on building an infrastructure, called Picture Talk, that will enable the deployment of mobile social computing applications on devices with a variety of capabilities. In our first application, "Rice Talk," we aim to enable users of mobile phones to participate in asynchronous conversations composed of voice posts, focused (optionally) around a picture or graphic (see Figure 1). Rice Talk is designed to respect present technical capabilities – primarily low-end phones lacking data capabilities and offering voice and numeric key presses as the primary interaction methods, along with a web-based interface appropriate for telecenters. However, we recognize the value of integrating pictures to help ground the conversation [Sarvas, Oulasvirta, Jacucci 2005] and thus are planning for the near future in which smart phones combining voice, data streams and interaction techniques like touch will become widespread.

Our current implementation [Farrell, Danis, Erickson, Ellis, Christensen, Bailey, Kellogg, to appear] incorporates pictures of people as a first step towards making people "first class" objects in the application. We expect to elaborate such tangible representations with computations on the behavior of participants in the conversation space along the lines we described earlier (e.g., recommendations, reputations, ratings). One area in which we expect these to be particularly helpful is in regard to navigation of the user generated content. Auditory interfaces pose well-known problems for navigation that we would expect to be even more difficult in applications like Rice Talk which will be primarily composed of dynamic (i.e., user-generated) content. Thus, adaptive navigation techniques are needed. Social filtering techniques [PHOAKS] based on computing similarity among participants to suggest a "browsing path" might help users of Rice Talk to find content that is of interest to them more efficiently and effectively than simply traversing the information representation in some pre-set (e.g., linear) order.

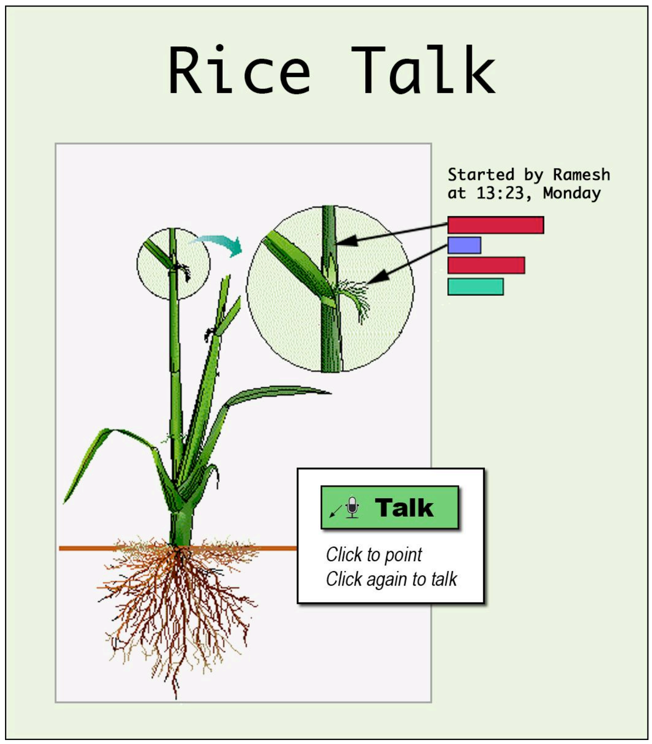

Fig. 1. Concept drawing of Rice Talk, a specialization of Picture Talk that allows a structured voice conversation around a picture or graphic of a rice plant.

We are in the process of identifying appropriate field sites for both ethnographic work and deployment of Picture Talk. In the process of doing this fieldwork, we hope to come to better understand the needs and characteristics of next billions users. As we select sites, we are hoping not only to work in developing countries but also to find at least one site close to our lab that can serve as an "analog" population – a population that has similar cultural, literacy, and technology use attributes to our targeted developing nations communities. While clearly not identical to the next billions, such surrogates are more accessible to us and have been shown to provide early insights into the characteristics and needs of far off populations [Best, Smyth, Serrano-Baquero, Etherton 2009].

8. CONCLUSION

In summary, we hope that by learning the social practices and goals of the "next billions" we can design sustainable mobile applications. Our approach is to use social computing techniques to meaningfully extend the existing social practices in the community, spread use of technology, and increase the visibility of local knowledge.

REFERENCES

ABRAHAM, R. 2007. Mobile phones and economic development: Evidence from the fishing industry in India. *MIT Press Journal*, **4(1)**, pp. 5-17.

ACKERMAN, M., HALVERSON, C., ERICKSON, T., AND KELLOGG, W.A. (eds). 2008. *Resources, co-evolution and artifacts: Theory in CSCW*. Springer.

AMAZON. http://www.amazon.com.

BEST, MICHAEL L., SMYTH, THOMAS M., SERRANO-BAQUERO, D., ETHERTON, J. 2009. Designing for and with Diaspora: A Case Study of Work for the Truth and Reconciliation Commission of Liberia. *Proc. CHI 2009*, ACM Press.

CHIPCHASE, J. 2006. Shared phone use. Future Perfect blog. http://www.janchipchase.com/sharedphoneuse. Accessed 2-23-09.

COOK, K.S. (ed.) 2001. *Trust in society, volume II*. Russell Sage Foundation Series on Trust. New York: Russell Sage Foundation.

EBAY. http://ebay.com.

ERICKSON, T., SMITH, D.N., KELLOGG, W.A., LAFF, M., RICHARDS, J.T., AND BRADNER, E. 1999. Socially translucent systems: Social proxies, persistent conversation, and the design of "Babble." *Proc. CHI'99*, ACM Press.

ERICKSON, T. E. AND KELLOGG, W. A. 2000. Social translucence: An approach to designing systems that support social processes. *ACM Transactions on Computer-Human Interaction (ToCHI)*, **7(1)**.

FACEBOOK. http://facebook.com.

FARRELL, R. DANIS, C., ERICKSON, T., ELLIS, J., CHRISTENSEN, J., BAILEY, M. AND KELLOGG, W. A Picture and a Thousand Words: Visual Scaffolding for Mobile Communication in the Developing World. *To appear in* Handheld Computing for Mobile Commerce: Applications, Concepts and Technologies, Wen-Chen Hu and Yanjun Zuo (Eds.).

GAKURU, M. AND TUCKER, RCF. 2009. Sustainability of Research and Development: A Case of Successful Technology Transfer in Spoken Language Technology. Paper presented at the workshop on Human-centered Computing in International Development, CHI 2009, Boston, MA, April 4-5.

GOPAKUMAR, K. 2006. E-governance services through telecentres: Role of human intermediary and issues of trust. *Proc. International Conference on Information and Communication Technologies and Development (ICTD)*.

HERSMAN, E. 2008. African mobile phone statistics. http://whiteafrican.com/2008/08/01/2007-african-mobilephone-statistics/. Accessed: 9/26/2008.

HILL, W.F., HOLLAN, W. D., WROBLEWSKI, D. AND MACCANDLESS, T. 1992. Edit wear and read wear. *Proc. Human Factors in Computing Systems (CHI'92)*.

HOOK, K., BENYON, D., AND MUNRO, A., (eds.) 1999. *Social navigation of information space.* Springer.

KENISTON, K. 2002. Grassroots ICT projects in India: Some preliminary hypotheses. *ASCI Journal of Management*, **31(1, 2)**.

KENISTON, K. AND KUMAR, D. (eds.). 2004. IT experiences in India: Bridging the digital divide. Sage.

KUMAR, A., RAJPUT, N., AGARWAL, S., CHAKRABORTY, D., AND NANAVATI, A.A. 2008. Organizing the unorganized: Employing IT to empower the under-privileged. *Proc. WWW*, Beijing, China.

MOYO, D. 2009. Dead Aid: Why Aid is Not Working and how there is Another Way for Africa. Farrar, Straus and Giroux, New York, NY, 2009.

NARAYAN, D. & GLINSKAYA, E. (eds.). 2007. *Ending poverty in South Asia: Ideas that work.* The International Bank for Reconstruction and Development / The World Bank.

PHOAKS. http://www.cs.indiana.edu/~sithakur/l542_p3/index.html

PRAHALAD, CK. 2005. The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits. Wharton School Publishing, Upper Saddle River, NJ, 2005.

RANKIN, Y., THOMAS, J. AND NDAWE, J. 2009. Tightly Integrating Cultural Exploration and Understanding into Design. Paper presented at the workshop on Human-centered Computing in International Development, CHI 2009, Boston, MA, April 4-5.

RESEARCH GROUP ON THE GLOBAL FUTURE. 2009. A Portal on Sustainability: A History of Sustainability. http://www.cap-lmu.de/fgz/portals/sustainability/history.php. Accessed on 4/21/2009.

RHEINGOLD, H. 1993. *The virtual community: Homesteading on the electronic frontier.* Addison Wiley.

RNCOS. 2008. Global Mobile Phone Penetration to Reach 50% in 2008. RNCOS Industry Research Solutions, 2008. http://www.rncos.com/Blog/2008/05/Global-Mobile-Phone-Penetration-to-Reach-50-in-2008.html. Accessed: 9/26/2008.

SARVAS, R. OULASVIRTA, A. AND JACUCCI, G. 2005. Building Social Discourse Around Mobile Photos – A Systemic Perspective. MobileHCI'05, Salzburg, Austria.

SLASHDOT. http://Slashdot.org.

SRINIVASAN, J. 2007. The role of trustworthiness in information service usage: The case of Parry information kiosks in Tamil Nadu, India. *Proc. International Conference on Information and Communication Technologies for Development (ICTD)*.

TWITTER. http://twitter.com.

UPHOFF, N.T. 1992. Local institutions and participation for sustainable development.

WIKIPEDIA. 2008. One laptop per child. http://en.wikipedia.org/wiki/One_Laptop_per_Child. Accessed: 9/26/2008.