WORLD ECONOMIC FORUM ITAFE INITIATIVE

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IT Access for Everyone – Global Benchmarking Study

January 2005

Written By:

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ITAFE Companies:

Accenture	Ingram Micro
AMD	Institute for Connectivity in the Americas
BMC Software	Intel
Cisco	Philips Electronics
Dell	Synopsys
Global Learning Ventures	VeriSign

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Executive Summary

Launching the IT Access For Everyone Initiative

At the World Economic Forum's 2004 annual meeting companies from the IT and Telecoms industry – Accenture, AMD, BMC Software, Cisco, Dell, Global Learning Ventures, Ingram Micro, Institute for Connectivity in the Americas, Intel, Philips Electronics, Synopsys and VeriSign – launched the IT Access for Everyone Initiative (ITAFE). The ambition initially was to create an affordable low-cost internet enabled device. However, early on in the discovery process, ITAFE realized that a hardware device is only a single – though highly important – part of a complex value chain that must be secured for disenfranchised populations to have access to ICT. Other critical elements include power, connectivity, relevant software applications, training, support and maintenance, cost structure and financing.

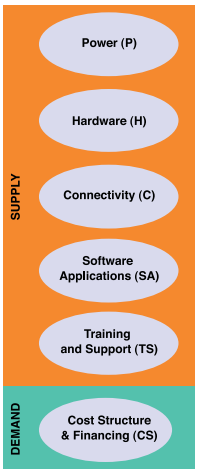
Upon evaluating dozens of case studies of ICT initiatives in developing countries around the globe, ITAFE determined that while a device is important, the real challenge is to create an ecosystem of organizations that could effectively deliver on each of those elements of the value chain in a sustainable and scalable manner. Thus, ITAFE focused its efforts on understanding which business models of previous initiatives had been proven effective, leading to sustainability and scalability.

The ITAFE framework and the analysis of dozens of case studies around the globe are set forth in this white paper. The framework has informed the quantitative and qualitative research the ITAFE team has done in Brazil, ITAFE's pilot country. The 2004 results of the work conducted by ITAFE in Brazil are included under separate cover.

The ITAFE Framework

- Like a greenhouse which requires the interaction of water, soil, sun to reach its end result, ITAFE realizes that the existence of a single hardware device is insufficient to result in a relevant and meaningful acceleration of Internet adoption worwide. Both **supply** and **demand** need to be taken into consideration.

- ITAFE quickly learned that demand for an ICT initiative is not only understanding the customer and their needs and their willingness and ability to pay for services, but thinking creatively about **cost structure and financing** arrangements that enable bottom of the pyramid consumers to gain access to ICT tools.



ITAFE Framework

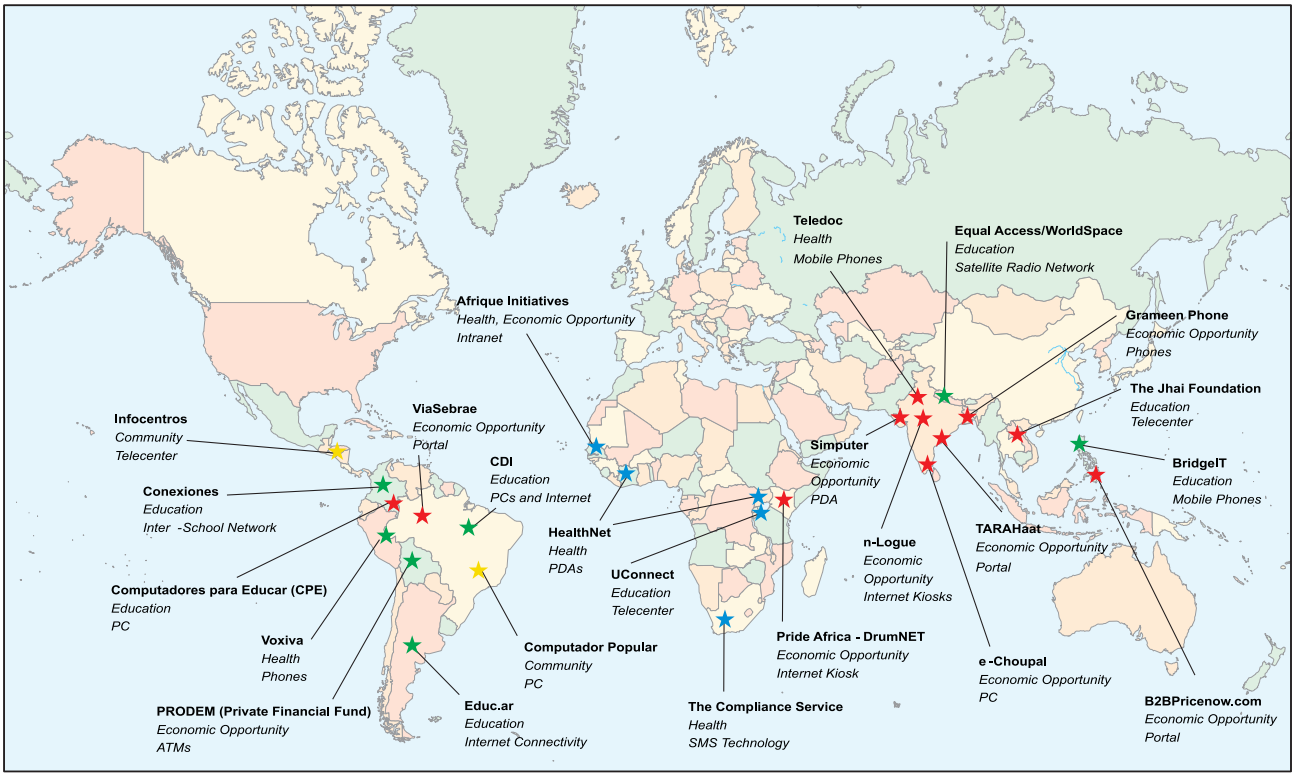
- The supply elements of the ecosystem are equally important, particularly **power, connectivity, hardware,** relevant **software** applications, **training** and **support.** How each of these factors interacts with the others determines both the quality of the solution for the end-user and the cost.
- The interaction between supply and demand determines the **sustainability** and **scalability** of the overall solution. While the developing world is littered with ICT initiatives, few have achieved balance between supply and demand and thus it is the exceptional initiative that reaches scale.
- None of the elements of the ITAFE **ecosystem** can be considered in isolation. Each has a significant impact on a potential business model. The full ecosystem and the interplay between supply and demand factored into the design of the ITAFE pilot in Brazil.

Global Scan

ITAFE's research was designed to help the ITAFE team understand the critical success (and failure) factors in ICT initiatives around the globe. Over 50 cases from around the globe were initially reviewed. From those fifty plus projects, two dozen were selected for deeper analysis. The projects identified for in-depth research were primarily selected for one of more of the following reasons:

- Overall applicability to ITAFE's goal: to provide access to IT to those currently denied access for infrastructure, financial or other reasons
- Project focus fell into one of the following four areas: economic empowerment, health, education, community
- Illustrative value for the ITAFE framework
- Availability of research/information
- Mix of developing and emerging country geographies and economic realties

Executive Summary



Each of the two dozen initiatives was analyzed through the lens of the ITAFE framework. The elements constituting supply and demand – power, connectivity, hardware, software and applications, training and support and cost structure and financing – were individually studied and best-of-breed examples identified, both within each element of the ITAFE framework and overall.

Lessons Learned

The global projects researched led to several key lessons for ITAFE's efforts in 2004:

- **Focus relentlessly on end-user needs.** The projects that failed most abysmally did not have a focus on the end-user. In those situations typically a donor and/or NGO had conceptualized what they believed the end-user to need and designed a project to those specifications. But when the solution was rolled out, the needs of the end users differed from the perception of what their needs were. Rigorous, structured, grass roots research of end-users needs, to the contrary, has yielded much higher success rates in ICT4D initiatives. Hand-in-hand with the focus on end-user needs is the importance of recognizing the potential of the bottom of the pyramid producers and consumers.

- **Build strong consortium that holistically incorporates each of the "must-have" elements.** Every single successful project analyzed went about creating their particular ICT4D solution through the creation of a consortium that systematically addressed both the supply and demand components of the framework: power, connectivity, hardware, software and applications, training and support, and cost structure and financing.

- **Create robust business model for each partner.** Part and parcel of building a strong and robust consortium is the building of a sustainable business model, for each member of the consortium. The most successful projects from around the globe understood that their success was only as strong as the weakest member of the consortium. Hence, great care was taken to ensure that the incentives of all business partners are aligned.

Executive Summary

- **Focus on niche market.** The most successful projects took into account competitive dynamics and industry interests and carved out a specific market for themselves. That allowed a wider breadth of consortia members to participate than would have been possible if potential partners had felt their "bread and butter" businesses were at risk of being cannibalized.

- **Capitalize on entrepreneurialism.** The initiatives that have attained the greatest scalability and replicability have harnessed the entrepreneurial spirit of those in the field. "Ownership" in the form of co-investment or sole investing, oftentimes through the use of micro-finance, has proven to be a key to success. The franchise model has been particularly effective in engaging otherwise "disenfranchised" members of society, such as women, in strategies that improve their livelihood. Local buy-in and designing initiatives with local capacity in mind is essential.

- **Attack cost structure and financing from multiple angles.** Many ICT4D initiatives have lost momentum or died completely due to reliance on a single cost structure or financing model. Those with a multi-pronged approach to thinking creatively about cost structure and financing without a reliance exclusively on any one funding source (particularly government) have enjoyed the greatest success.

- **Focus on tackling a specific issue at the outset with a view to expanding scope once the program is up and running.** Initiatives the quickest to lapse into failure were ones that were too ambitious at the outset versus those that started with concrete, modest objectives, worked out any kinks in processes and then expanded operations. However, equally important, is starting out with the expectation of the expansion of scope. Successful, scalable projects started small but designed processes at the outset to accommodate increased capacity in the projects' near future. Less successful ones created a model that worked on a pilot basis but did not prove scalable.

- **Establish sufficient set-up funding and core investment relations to ensure pilot project will be fully funded.** A key element of developing this business model was attracting sufficient funding from corporations and investment organizations to cover set-up costs. Successful initiatives built strong relationships with these partners and managed these relationships well to ensure that funding for expansion was forthcoming. Corporate relationships also enhance the profile and visibility of a project.

- **Build strong government relations when operating in a vertical which is heavily influenced by government policy but do not rely solely on government support for a project's success.** ICT initiatives are prone to need certain levels of government support. Hence, gaining government buy-in early in a project's life-cycle is critical. Strong government relationships are key to projects which use cellular and switched networks because in many developing countries they remain state-controlled. It should be noted, however, that working with governments particularly in developing world contexts often incurs time lags not experienced in business and requires the development of a specific set of negotiation and relationship management skills. The most successful projects while gaining government support have built business models that are not reliant solely on on-going support from government.

Local Application of ITAFE: Brazil

Using the global framework and methodology to guide its efforts, ITAFE has been researching the Brazilian market. ITAFE work in Brazil done in 2004 includes extensive qualitative and quantitative research, particularly on the demand side of the equation. Through extensive market surveys and analysis and using the global framework and methodology, the local Brazil team has done initial economic modeling that begins to demonstrate how the different elements of the ITAFE "greenhouse" might work together in Brazil to create a sustainable, viable business model for all organizations involved. ITAFE's efforts in 2005 will focus on honing and refining the Brazilian business model, building the local consortia to deliver on the business solution, launching the pilot and creating the tools necessary to potentially expand ITAFE to other locations.

Context for ITAFE

At a formal session during the World Economic Forum's 2004 Annual Meeting, leaders from the IT and Telecoms industry concluded that, to date, no government or business entity – or a combination thereof – had delivered a truly affordable wireless connectivity computing device along with the infrastructure meant to support it in the developing areas of the world. As a result, they initiated, through the World Economic Forum, a project to explore the characteristics of an access device designed specifically to enable basic computing and Internet access in the developing regions of the world.

The objective of the IT Access for Everyone (ITAFE) initiative is to research the relevance and feasibility of developing simple, low-cost, wireless/Internet enabled device(s) with the features of a PC that is truly affordable in the developing regions of the world. The following organizations are engaged in the ITAFE initiative: Accenture, AMD, BMC Software, Cisco, Dell, Global Learning Ventures, Ingram Micro, Institute for Connectivity in the Americas, Intel, Philips Electronics, Synopsys and VeriSign.

The ITAFE "Greenhouse"

Like a greenhouse which requires the interaction of water, soil, sun to reach its end result, ITAFE realizes that the existence of a single hardware device is insufficient to result in a relevant and meaningful acceleration of Internet adoption worldwide. A hardware device is only a single – though highly important – part of a complex value chain that must be secured for value to be realized. Other critical elements of the "greenhouse" include:

- Power
- Connectivity
- Relevant software applications
- Training, support and maintenance
- Cost structure and financing

How each of these factors interacts with the others determines both the quality of the solution for the end-user and the cost. Moreover, the interaction among and between these elements will determine the sustainability and scalability of the overall solution:

Power. Research indicates that 2B of the world's 6B people do not have access to electricity. Therefore, any solution ITAFE creates must consider power options that do not rely on users being on the "grid" if ITAFE is to result in a relevant and meaningful acceleration of Internet accessibility to a third of the world's population.

Connectivity. A device alone will not work without concomitant infrastructure enabling access to the Internet. There are several innovative technologies with respect to connectivity, such as wireless, that could greatly improve the quality, and reduce the total cost, of the solution to the end user. ITAFE will consider regulatory realities, price, providers and the prevalence of innovative connectivity options in designing its overall solution. If needed, ITAFE will make recommendations on how the regulatory environment in a particular country or region could be altered to possibly expand IT access.

Software Applications. Hardware without the availability of applications to run on it is useless. Many IT projects have failed due to lack of consideration of software applications. This is particularly true in the developing world. Software needs to be relevant, provided in the local language and contextualized to local conditions and needs. Moreover, a software solution designed to solve a particular problem oftentimes mandates critical "features" of a given hardware solution (e.g. screen size, speakers, etc.). As such, the ITAFE approach will include a careful analysis of software options, both existing and proposed.

Training, Maintenance and Support. Training, support and maintenance go hand-in-hand with software applications as a critical "greenhouse" element. IT initiatives are renowned for failing due to lack of forethought around training and implementation. The kind of support and training anticipated for a particular use of a device obviously has a large impact on the design of the device itself and will be taken into consideration in the ITAFE process.

Cost Structure and Financing. In reviewing successful IT projects in the developing world, ITAFE has learned that the most successful models structured innovative financing models from the project's inception. Many of them allow for multi-users (versus a model of one device

Context for ITAFE

per user). Others employ micro-credit institutions to help consumers/entrepreneurs fund the purchase of a solution/device. Others yet have government or other institutions "seed demand." The willingness and ability of consumers to pay, or for government to fund an initiative, obviously has important implications for the design of a prototype, as might a multi-user approach.

None of these elements of the ITAFE "green-house" can be considered in isolation. Each has a significant impact on ITAFE research and the design of ITAFE project prototype(s).

ITAFE Objectives for 2004

Hence, in 2004 ITAFE focused on both *creating an overarching global framework and methodology* that can be used for multiple locations and *conducting the local research needed to deploy a project in Brazil.*

Global framework and methodology
The focus of the global research on each of the elements of the greenhouse has been to ensure that ITAFE incorporates any and all key lessons learned from previous like initiatives and does not repeat their mistakes. To begin, ITAFE surveyed over fifty IT projects in developing and emerging countries. Approximately two dozen of those fifty IT projects, some of which were successful and a number of which did reach their stated aims, were then selected for in-depth analysis. ITAFE's goal was to find patterns and key lessons among those two dozen projects to guide its future efforts, lest ITAFE fall prey to the same mistakes many initiatives in the developing world aspiring to the same end have. This white paper is the summary of that research and an outline of analytical tools built and designed on the experience of the many IT projects, both failures and successes, which have preceded ITAFE.

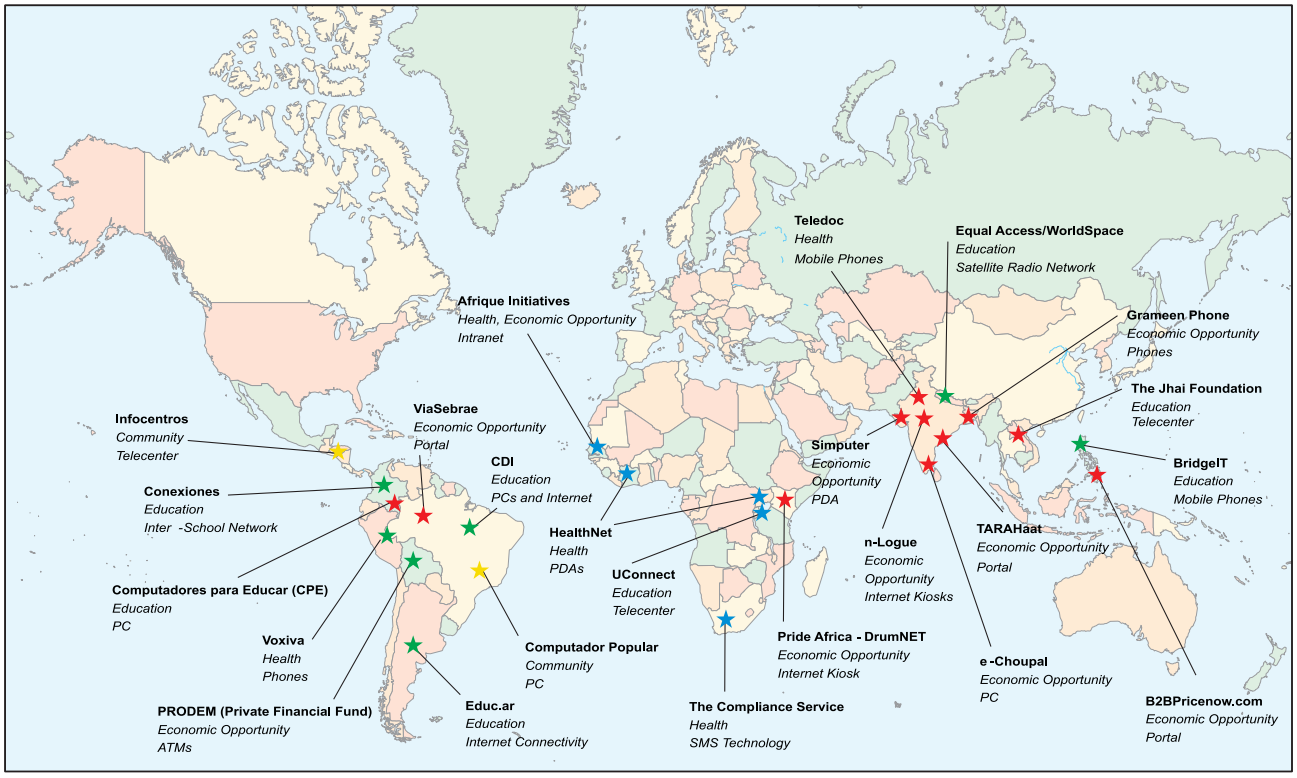
Local research and creation of business case
Concurrent to the research being done on best practices around the globe, and using the global framework and methodology, ITAFE has been researching the Brazilian market. ITAFE work in Brazil this year includes extensive qualitative and quantitative research. The local Brazil team, using the global framework and methodology, has also created a business plan that will, among other things, articulate how the different elements of the ITAFE "greenhouse" will work together in Brazil to create a sustainable, viable business model for all organizations involved. The business plan identifies preliminary members of the "greenhouse" or consortia in Brazil who through collaboration will be able to deliver on the business case. Such a consortia might include, for example, a local development shop that can write the necessary software in local language, a local NGO able to provide training and support, a micro-finance institution willing to underwrite loans to ITAFE's end-users, as well as hardware and connectivity providers delivering on the device portion of ITAFE's solution.

Global Scan

In conducting its research, ITAFE surveyed over 50 cases from around the globe spanning every continent. From those fifty plus projects, two dozen were selected for deeper analysis. The projects identified for in-depth research were primarily selected for one of more of the following reasons:

- Overall applicability to ITAFE's goal: to provide access to IT to those currently denied access for infrastructure, financial or other reasons
- Relevance of project focus fell into one of the following four areas: economic empowerment, health, education, community
- Illustrative value for the ITAFE framework
- Availability of research/information
- Represented a mix of developing and emerging country geographies and economic realities

Map Overview



Global Scan

Brief Summary of Projects

Continent	Country	Project Name	Vertical	Summary
Africa	South Africa	**Vodacom**	Community	As part of Vodacom's Community Service program the company sets up entrepreneurs with their own containers from which to provide phone access to remote areas on South Africa.
Africa	Senegal	**S.A.R.L.**	Economic Opportunity	Saint Louis Net, S.A.R.L., a for-profit business offering IT-based services to the community.
Africa	Senegal	**Manobi**	Economic Opportunity	Manobi is a multimedia service operator for professionals in the rural sector and agribusiness. In Senegal, mobile phones and the Internet have been used to provide multi-channel business services to farmers, with the T2M market information system providing strategic information to farmers through WAP enabled phones.
Africa	Kenya	**Price Africa - DrumNet**	Economic Opportunity	A project of PRIDE AFRICA (PA) designed to deliver financial and information services for mainstreaming resource-poor farmers.
Africa	South Africa	**UUNET Bandwidth Barn**	Economic Opportunity	The UUNET Bandwidth Barn is an incubator for ICT start-ups in the Western Cape set up by the Cape Information Technology Initiative, a not-for-profit agency focused on developing the ICT sector in the Western Cape.
Africa	Regional	**African Virtual University**	Education	Founded to address the critical needs for increased access to quality tertiary education in Sub-Saharan Africa, building capacity and supporting economic development by leveraging the power of modern telecoms technology.
Africa	Regional	**Freeplay Foundation**	Education/ Community	Recognizing a need for alternative energy sources amongst the world's poorest communities, the Freeplay Foundation was founded as an extension of the Freeplay Energy Group's commitment to development and empowerment.
Africa	Uganda	**Uconnect**	Education	The object of Mission Mobile Education's Uganda Connect project is the advancement of public education, health, agriculture and other sectors in Uganda, using ICT to improve the quality and efficiency of communications through the provision of necessary hardware and software and the training of teachers and managers.
Africa	South Africa	**The Compliance Service**	Health	For-profit project set up by a South African doctor to prevent non-compliance of patients with TB medicine.
Africa	Uganda	**HealthNet**	Health	HealthNet Uganda (HNU) and SATELLIFE have addressed the challenges of healthcare in Uganda by supporting a low-cost email network for health professionals in Kampala and beyond, distributing e-mail based information and providing computer literacy training and technical support. In addition, HNU supports the computer network at Makerere Uni's Faculty of Medicine where it is housed.

Global Scan

Continent	Country	Project Name	Vertical	Summary
Africa	Senegal	**Afrique Initiatives/ Pesinet**	Health	Pesinet is a non-profit organization focused on preventative health care. Its mission is to improve the health of children less than 5 years of age in the poor communities of Saint Louis.
Asia	Philippines	**B2BPrice.now**	Economic Opportunity	E-marketplace for farmers, fisherfolk and SMEs to access market prices and trade products. Available via website or cell phone.
Asia	Philippines	**Bridge IT**	Economic Opportunity	Global program to deliver digital education materials to schools using mobile technology. Interactive multimedia learning materials become accessible to local classrooms around the world.
Asia	India	**e-Choupal**	Economic Opportunity	Web-based initiative offering farmers of India all the information, products & services needed to enhance farm productivity, improve farm-gate price realization and cut transaction costs.
Asia	Bangladesh	**Grameen Telecom/ Village Phones**	Economic Opportunity	Aiming to provide easy access to telephone services, all over Bangladesh. To initiate a new income generating option for villagers and gradually bring the full potential of ICT to their doorsteps.
Asia	India	**n-Logue**	Economic Opportunity	n-Logue has created a franchise model to set-up shared-access village kiosks designed to provide Internet and phone system access to remote areas of India.
Asia	India	**PicoPeta (Amita Simputer)**	Economic Opportunity	Aim was to design easy to use software which would include Indian language software, be cheap to produce and enable economic, health and education initiatives across India.
Asia	India	**TARAhaat**	Economic Opportunity/ Community	TARAHaat uses a franchise-based business model to bring computer and Internet technology to rural regions and plans to use these technologies to create revenue streams leading to financial viability for itself and its franchises.
Asia	Nepal/Global	**Equal Access/ WorldSpace**	Education	Equal Access focuses on combining two key resources - cutting edge Information and Communications Technologies and the passion of people to make a meaningful difference. Challenge is to “fire up people’s imaginations, tap into their potential to make real differences and engage them as central players in issues concerning their own development.”
Asia	Laos	**Jhai Foundation**	Education/ Economic Opportunity	Established to provide connectivity in remote areas in Laos with the aim of promoting self-sustainable models for education and economic opportunity.
Asia	India	**TeleDoc**	Health	Teledoc uses leading-edge communications capabilities to bring high-quality healthcare directly to patients using GPRS mobile networks.

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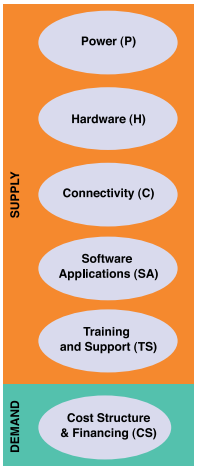
Continent	Country	Project Name	Vertical	Summary
Latin America	Brazil	**Computador Popular**	Community	The CP project was sponsored by the Brazilian government with the aim of providing low-income Brazilians with access to information technology and to get more people online.
Latin America	El Salvador	**Infocentros**	Community	Aims to contribute to the national development of democratization through providing access to knowledge, publications and the exchange of information.
Latin America	Bolivia	**PRODEM FFP**	Economic Opportunity	The business model was designed to meet the needs of bottom-of-the-pyramid customers by developing accessible and low-cost banking services. It targets low-income communities and the entrepreneurs and micro- to medium-size enterprises that constitute Bolivia's informal economy, offering a wide range of savings, credit and money transfer services.
Latin America	Brazil	**ViaSebrae**	Economic Opportunity	Aims to provide a platform for small businesses to "conduct e-commerce activities that they would otherwise be unable to afford". Project was consistent with Sebrae's mission of "working in a strategic, innovative and pragmatic way so that small business in Brazil had the best possible conditions for sustainable development, contributing to the general evolution of the country".
Latin America	Brazil	**CDI**	Education	Non-profit NGO that has used IT since 1995 to promote social inclusion via Information Technology and Citizens Rights Schools. Provides equipment (hardware and software), training and administrative and technical support to schools which are self-managed and sustainable but monitored by regional CDI offices.
Latin America	Colombia	**Computadores para Educar**	Education	Aims to establish a permanent flow of computers to public schools in all regions of the country, offering new generations and communities access to better opportunities for education, knowledge and progress.
Latin America	Argentina	**educ.ar**	Education	Three-pillar strategy that intends to provide connectivity and computer equipment, teacher training and high-quality educational content to raise the standard of education for all Argentinean students. Mission is to improve reach and quality of educational content and tools available to Argentinean students and teachers while providing an Internet-based platform for collaborative learning across the country.
Latin America	Peru	**Voxiva**	Health	Voxiva's public health project in Peru created an international for-profit organization designed to facilitate reporting and communication with health professionals in areas without Internet access and to do so rapidly and with no investment in new hardware.

Global Scan

Design of ITAFE Matrix



In surveying projects around the globe, and measuring their success, ITAFE quickly realized that in many places there is great **demand** for innovative ICT solutions. For the right solution, consumers, even very poor consumers, are willing to pay particularly with an innovative *cost structure and financing structure.* However, the **supply** of ICT solutions (and scalability) is limited by the lack of *power, connectivity, hardware, software applications* and *training and support.* This observation – true across all projects studied – gave rise to the creation of an ITAFE matrix, focused on both supply and demand, describing the elements an initiative focused on ICT4D "must have" in order to succeed.

Success means scalable and sustainable impact on a population that prior to the project's implementation did not have access to the kind of IT service now available to them (communication, health, education, etc.) and as a result of the project the population served will enjoy the benefits of IT access for years to come. While there are certainly other important elements in making an ICT4D project successful, the inclusion (or lack of inclusion) of these six elements reflecting both the supply and demand side of the equation – power, connectivity, hardware, software and applications, training and support and cost structure and financing – had a dramatic impact a given project's success, *without exception.*

Supply

Power: A reliable, sustainable and locally appropriate source of power is a key element on the demand side of the framework, particularly in a world where 2 billion people, mostly in rural areas do not have access to electricity.[1] An assessment of the criteria required to provide power, as outlined by the ITAFE matrix, highlights a number of key constraints linked to sustainability, reliability and scalability which may significantly impact an initiative's success or failure. Successful initiatives are those which understand these constraints and design solutions which overcome them, building incrementally on existing infrastructure and using innovative, reliable and cost-effective sources of power.

Connectivity: Reliable, sustainable and cost-effective connectivity – be it landline, mobile GSM or wireless or satellite – is essential for the majority of ICT initiatives. However developing countries, particularly remote areas, often lack the infrastructure to provide robust connectivity, in addition to facing regulatory constraints around the licensing of networks and access to competitive connectivity options. In a global population of 6.3 billion there were only 843 million main lines in use in 2003 and 604 million Internet users.[2] ICT4D initiatives therefore need to focus as much as possible on using existing infrastructure or on promising new technologies such as wireless or satellite to overcome these constraints.

Hardware: Hardware forms another key infrastructural element of the ITAFE framework which must be considered closely in order to develop a successful ICT4D initiative. The chosen hardware – be it a PC, PDA or mobile phone – must be fit-to-purpose not only in its ability to run the relevant software and applications but also its compatibility with an initiative's power and connectivity capabilities. ICT initiatives tend to use or adapt existing hardware or develop new hardware for their purposes and each approach attracts different costs and complexities.

Software and Applications: The software and applications used by the ICT initiatives are designed to meet the requirements of a specific vertical, such as education, health or economic opportunity. On the whole, different verticals provide ample opportunities for a variety of software solutions but tend to suffer from similar constraints. Overcoming these constraints requires a clear understanding of the criteria under which software and applications in ICT initiatives are successfully used, which includes their fit to user requirements and the available technical infrastructure and the usability of the

1 UNDP website, 2004, www.undp.org/energy/

2 CIA factbook, 2004 www.cia.gov

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solution. The design of an initiative's software and applications and their fit-to-user requirement are essential to ensure success, sustainability and scalability.

Training and Support: Consideration of the types of training and support available for ICT initiatives, and the logistics needed to properly deliver the training and support necessary, is a key measure of sustainability within the ITAFE framework. Both services can be offered as local or remote services or as a combination of both. The option chosen will be affected by and impact upon the existence and development of IT capacity.

Demand

Cost Structure and Financing: The cost structure and financing of ICT initiatives is the key element in their design which ensures both start-up and sustainability. The majority of projects adopt a mixed model of financing and most are designed to move towards self-sustainability after a pilot stage. The funding program and business model chosen not only determine the strategic roll out of a project but also heavily impact upon elements such as local buy-in and ownership and relations with the government. Careful consideration of the type of cost structure and financing adopted is therefore required given that the decisions taken have an immediate and long-term impact upon the initiative's success, its scalability and its sustainability.

High Level Observations

While the last section of this paper details "lessons learned" at a more detailed level, there are three high level observations ITAFE made through the study of both successful and non-successful projects and the development of the matrix worth noting at the outset.

Understanding Demand

Projects that took a detailed and structured approach to understanding the specific problem they were trying to solve and then focused on creating a solution that met those very specific user needs succeeded more frequently than those solutions created based on a perceived need of end users. Understanding your customer and their needs, particularly the needs of those customers at the 'bottom of the pyramid' and their willingness to pay, is essential to the successful implementation of a project. In other words, demand as well as supply matters greatly when planning an ICT4D initiative.

Building the Whole Ecosystem

How the must-have elements work together within the larger context of the project is more often than not the determining factor in a project's success or failure than achieving perfection on any one of the individual elements. The "must-haves" interact with one another much like a greenhouse. Soil or sun or water alone will not give rise to beautiful flowers. Nor will the same combination of soil, sun and water have a like-effect on sunflowers, orchids and ferns. Only when soil, sun and water are carefully meted in the right proportions and combination for a particular flower will the desired outcome be met. The same holds true for ICT4D initiatives. A hardware device alone in a developing world context is useless. As much care needs to be given to the availability of power and connectivity and to the accessibility of relevant, useful software applications and training. And all of these elements are tied together through proper cost structure and financing.

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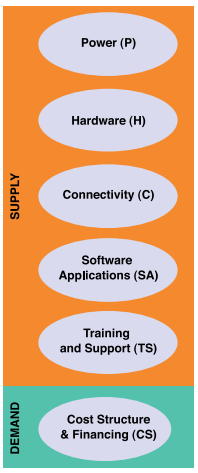
Appropriateness of the Solution

There is rarely "one right answer" with respect to a particular choice that an ICT4D project makes in any of the of the "must-have" elements. However, the overall business model must drive the decision making about which of the "must-have" elements should be included and in what combination. The proper selection of the "must-have" element according to the purpose of the project and its environmental context is critical. Using electric as the source of power, for example, could very well make sense if the project is operating with a population that has access to mains power. However, if the intent is to reach rural swaths of the population off the electricity grid, a project's decision to work with renewable energy sources requiring little to no infrastructure is obviously the wisest choice. The most successful projects match the solution to a given problem with the corresponding "must-haves" weighing the trade-offs of each option. For example, purchasing a fully equipped, state of the art PC may seem like a wildly expensive alternative for poorer parts of the world, yet if there is a cost structure and financing model that supports the use of such a technology (such as a multi-user model) and the software application choice requires more robust functionality, a higher priced PC may be a better choice than the selection of a very low-cost handheld computer with limited functionality, despite the cost differential. But the very same PC might require more power than a handheld so thought needs to be given to the population the PC will serve and whether there are viable power and connectivity options to serve that population. PCs are also relatively complex so training and support, too, must factor into the decision-making process. Only when all of the "greenhouse" elements are considered together, in the context of the particular project, will the right outcome be clear.

ITAFE Matrix



The ITAFE matrix has six "must-have" components, each of which significantly influences the overall success of an ICT4D initiative.

In the paragraphs that follow, each element of the matrix – power, connectivity, hardware, software and applications, training and support and cost structure and financing – is explored. The structure for each element of the matrix is as follows:

- an introductory overview
- description of the possible options (e.g. power options include mains, battery-operated, renewables, etc.)
- exploration of the criteria by which each of options are evaluated in the context of an ICT4D project (affordability, reliability, scalability, etc.)
- description of best-of-breed examples of innovative and creative solutions for each "must-have" element of the matrix including an indicative assessment of the relative success of each initiative in relation to the particular "must-have"[3]
- key lessons learned for each component of the matrix

Broadly speaking the matrix can be thought of as breaking down into technological infrastructure (hardware, power and connectivity); human infrastructure (training and support) and organizational and financial infrastructure (cost structure and financing) and it is in this order that the specific components of the matrix will be discussed.

Power

Introduction

By definition, technology lies at the core of ICT4D and the provision of power, hardware and connectivity is frequently a significant challenge in developing world contexts. A reliable, sustainable and locally appropriate source of power is, therefore, a key element on the demand side of the framework, particularly in a world where 2 billion people, mostly in rural areas, do not have access to electricity.[4] An assessment of the criteria required to provide power, as outlined by the ITAFE matrix, highlights a number of key constraints linked to sustainability, reliability and scalability which may significantly impact an initiative's success or failure. Successful initiatives are those which understand the constraints and design solutions which overcome them, building incrementally on existing infrastructure and using innovative, reliable and cost-effective sources of power.

Sources of power

Power sources for ICT initiatives can be divided simply into mains provision and stand-alone generators of power that exist separately from the mains infrastructure. The ITAFE matrix identifies five main types of stand-alone power used in ICT initiatives; batteries, generators, solar power, wind-up power, and bicycle cranks. This is not an exhaustive list of the stand-alone options available on the market but indicative of those historically preferred in ICT4D. Nor is it always the case that a single source of power is used for any one initiative. More frequently, power sources will be combined to ensure a reliable source of power that meets the volumes required by an initiative's hardware.

Mains power

Mains power is the most frequently used source of power for the majority of ICT initiatives on the basis that, where the correct infrastructure is in place, it is the most cost-effective and efficient means of reaching a large number of people. However, it is reliant firstly on the existence and ongoing maintenance of power lines and secondly on the financial ability of individuals or communities to connect to the grid. For the 2 billion people without access to the electricity network in the rural areas and informal settlements in and around cities in much of the developing world, lack of infrastructure and low-incomes are combined to constrain connection to the grid.

3 This assessment is based on a subjective judgement of the relative success of initiatives studied for the ITAFE matrix and should not be taken as a definitive judgement of an initiative's ability to use each of the matrices "must-haves". Rather the assessment should serve as a quick guide to inform the reader as to how well a particular initiative met the criteria on which the must-have is being assessed within this report.

4 UNDP website, 2004, www.undp.org/energy/

ITAFE Matrix

Batteries and generators
On the basis of cost and access, therefore, there are many advantages to stand-alone options for the generation of power. Non-renewable sources of power, such as generators and batteries, are readily available, allow individuals to overcome geographical constraints and are therefore often used in areas off the grid or as a back-up supply where outages are a frequent occurrence. For many consumers, however, the cost of running a generator or buying and/or recharging batteries can also be prohibitive. Nor does either option, however, offer either an environmentally sound alternative to mains power.

Renewable sources
Renewable sources of power in contrast offer an environmentally-sound alternative to extending the reach and reliability of power supplies. Whilst often incurring a higher initial set-up cost, their reliance on natural renewable sources also means they can be much cheaper to run than batteries or generators. Solar power, for example, has been adopted by a number of initiatives in developing world contexts because its technology is relatively advanced and can be used to power small- and large-scale hardware, connectivity and facilities at a relatively low, and falling, cost. Similar options, such as wind turbines or hydroelectricity, also offer renewable sources but are more expensive in set-up costs and often require large amounts of infrastructure and land to generate power as well as the infrastructure to relay electricity from source to the required point of usage.

Perhaps the simplest source of renewable energy harnesses human energy either through wind-up or bicycle (foot) crank generators. The resultant power source is independent, flexible, renewable, environmentally friendly and very mobile. Unfortunately it is seldom scalable beyond powering radios and mobile phones for a limited period of time and as such can seldom be used as a sole power source for an initiative.

The future for power
A number of new sources for generating power have been developed and marketed over the last ten to twenty years. Some such as solar power have seen widespread adoption and have met requirements in remote areas extremely effectively. HP, for example, is testing a solar fabric with itinerant photographers in South Africa that costs 80% less than traditional solar panels and won't crack[5] whilst a number of NGOs are working in developing countries to develop the capacity to build solar panels and thus spread their usage whilst promoting entrepreneurialism.

Future sources of power, such as fuel cells, also offer environmentally-sound compelling alternatives, particularly in off-the-grid locations. Fuel cells have the added benefit that, unlike solar energy, they can store energy until it is needed and can be transported to where power is required. In addition to new sources, the ongoing manufacturing and innovation around existing renewable technologies such as solar will serve to drive down prices and hopefully to ensure that they become a more viable solution for ICT initiatives with an emphasis on affordability.

Criteria for assessing power

Given the variety of options available for the generation of power, a set of criteria are required to evaluate the relative pros and cons of each option. All ICT initiatives make an assessment at the outset of their power requirements and select an option or combination of options based on factors such as the volume of power required at present and ongoing, the infrastructure in place or feasibility of developing infrastructure, the affordability of power, the need for back-up given fluctuations in supply etc. On this basis the ITAFE matrix has assessed the relative benefits of different options of powering ICT initiatives based on the existing infrastructure in place, suitability, affordability, reliability, efficiency and environmental impact.

Existing infrastructure
Central to the provision of power is the existence of infrastructure, whether that is power lines, solar panels connected to a device or the existence of shops in which to purchase batteries. Assessing the success of power generation for an ICT initiative necessitates understanding how existing infrastructure was used or new infrastructure developed and the suitability of the provision of power to the geography, population density and infrastructure where the initiative was

5 Business Week "Tech's Future", September 27, 2004, www.businessweek.com/magazine/content/04_39/b3901013.htm

ITAFE Matrix

located. In some cases the choice to use mains electricity can act as a constraint on initiatives because it restricts the geographical reach of a project. Successful projects in extremely remote areas might instead choose a power solution which requires no infrastructure and is therefore a much more viable option than reliance upon a mains network.

Suitability
Not only must the power source chosen be compatible with existing or proposed infrastructure, it must also be compatible with the hardware used. The volume and reliability of an initiatives' power source must be fit-to-purpose for the hardware required. Equally, power sources need to be easy to use or to train people to use, as well as being accessible to multiple users.

Affordability
In using existing infrastructure but particularly in developing new infrastructure to provide power another key criterion is affordability. As touched on in the section above, different costs are incurred at different points in the provision of power, leaving some options more appropriate than others. For example, the central cost of mains electricity for the provider, particularly in remote areas with difficult terrain, is that of building and maintaining the required infrastructure. Where the infrastructure is in place, the cost for consumers of connecting to the grid and using mains electricity may be driven down by competition and the number of consumers in the market. However, although low-cost in relative terms, it may still be prohibitive for bottom of the pyramid consumers. In contrast, solar technology, particularly to power small items such as mobile phones or wall-sets, may be more expensive to set-up but self-sustaining on an ongoing basis. ICT initiatives must therefore assess the affordability of each solution given their intended consumers and decide on a power source or multiple sources accordingly.

Reliability
The reliability of the power supply is also a critical aspect of the fit-to-purpose of the power used for an initiative. Particularly where using PCs and similar hardware, a reliable power supply can be a key element which determines an initiative's success or failure. Ensuring that power supply is reliable is a question of understanding the possibility of outages, building in back-up options and guaranteeing that all possible maintenance and repairs capabilities possible are in place. The durability of equipment and its ability to operate in extreme environments may prove key depending on an initiative's location.

Efficiency
The reliability of power, alongside affordability, feeds into a question of the overall efficiency of different power sources for ICT initiatives. Efficient consumption of energy is often a built in factor to the hardware used by ICT4D initiatives, based on the fact that power supply may be intermittent or low. In the same way, the ITAFE matrix regards the efficient production and transport of energy as a vital decision-making factor for ICT initiatives.

Environmental impact
The final criterion upon which power provision for ICT initiatives should be assessed is environmental impact. In a developing world context where the regulation of power generation may be less well enforced, it is important to consider questions of pollution, wastage and the disposal of the infrastructure required to generate power. As discussed in the previous section, this can be an important balancing factor when considering the benefits of back-up options such as batteries for initiatives where outages are likely.

In sum, the criteria for assessing the relative benefits of power provision for the projects included in the ITAFE matrix are designed to measure the sustainability, scalability and reliability of the power sources, or combination of power sources used by different initiatives. Investigation of how different projects have tackled each of the criteria described above reveals a number of key constraints and solutions, recurring problems with power provision and innovative solutions to overcome them.

ITAFE Matrix

Devising solutions

Overcoming the problems associated with power supply requires the development of two main strategies, diversification and innovation. These are preferably built in to the design of the project and are in place at its start-up. However, a number of examples have also incorporated alternative power solutions once the project is underway in an attempt to overcome the constraints which have become evident.

E-choupal, India[6]

Criteria	Score
Fit to infrastructure	4
Affordability	4
Reliability	4
Efficiency	4

The e-Choupal internet kiosks developed by ITC in India would be one such example of a project forced to adapt to an initial failure to guarantee power supply. Faced with frequent power outages, in a country where only 56% of homes have access to electricity[7], ITC, an Indian private company, looked first to a battery-powered UPS (Unlimited Power Supply) back-up solution. However, this remained problematic as battery charging was still reliant on line power, and the company has therefore moved towards a diverse solution using solar-powered in conjunction with line power.

n-Logue, India[8]

Criteria	Score
Fit to infrastructure	5
Affordability	3
Reliability	5
Efficiency	4

A similarly diverse solution was devised by n-Logue, whose kiosks provide; a 16-hour back-up for telephone equipment, four-hour back-up for computers, and solar-powered wall-sets with battery stand-by systems in order to cover intermittency issues in electrified areas. In addition, kiosks set-up in areas off the electricity grid are provided with a petrol-start kerosene-run 400VA generator. However, whilst overcoming the problem of lack of infrastructure, such generators cost USD$213 to buy and run at a USD$0.10 per hour greater cost than electricity. The reality of providing off-the-grid power solutions is that they are often less cost-effective. However, the n-Logue case shows, and most initiatives would concur, that a marginal increase in operating costs can be justified given that power is critical for ICT and the alternative, to extend mains infrastructure, is both more costly and complex.

Freeplay Radio Foundation, Africa[9]

Criteria	Score
Fit to infrastructure	5
Affordability	5
Reliability	4
Efficiency	4

The second main strategy for overcoming power-supply constraints would be to design the project from the outset without a reliance on line power and infrastructure. One of the best examples of this approach is that of the Freeplay Radio Foundation, whose radios are human-powered through wind-up technology which requires no infrastructure to be in place. The radios can also be powered either by solar-energy or batteries, but by using wind-up they are maximize accessibility in remote areas and provide a mobile solution. Wind-up technology is under utilized in ICT4D projects but this is linked to the major constraint discussed above that it is less suitable for hardware which requires large volumes or constant supplies of power.

6 World Resources institute - Digital Dividend, Michigan Business School http://www.digitaldividend.org/pdf/echoupal_case.pdf August 2003
http://www.unitar.org/hiroshima/ief04/Case%20study/eChoupalYoon.pdf
C.K.Prahalad (2004) The Fortune at the Bottom of the Pyramid, Wharton School of Publishing

7 According to the 2001 census

8 July 2001 World Resources Institute http://www.digitaldividend.org/pdf/nlogue.pdf, http://www.n-logue.com/
M.L. Best & C.M. Maclay. Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle. The Global Information Technology Report 2001-2002:Readiness for the Networked World. Oxford University Press. 2002.
R. Kumar, A. Jhunjhunwala. Taking Internet to Village: A Case Study of Project at Madurai Region. MIT. 2002.
C. Blattman, R. Jensen, R. Roman. Assessing the Need and Potential of Community Networking for Developing Countries: A Case Study from India. 2002.

9 http://www.freeplayfoundation.org/

ITAFE Matrix

Jhai Foundation, Laos[10]

Criteria	Score
Fit to infrastructure	5
Affordability	4
Reliability	3
Efficiency	4

Cases of complete reliance on solar, wind or other renewable sources are rare. More usual would be the Jhai Foundation, which developed both an innovative and diverse power solution for low-energy PCs in remote Laotian villages without electricity. The Jhai PC runs on less than 20 watts in normal use and less than 70 watts when printing and is powered by bicycle (foot) crank generators. Solar-powered wireless relay points are located on hills close to the village and servers located 20km from the village by road continue to be powered by grid electricity. The entire solution therefore provides for a reliable, renewable and extremely cheap source of power in remote areas whilst utilizing mains grid electricity where it is available and where, running the server, it is of greatest value.

Key lessons

The most important lesson which emerges from studying power usage across ICT projects in the ITAFE framework is the importance of flexibility, sustainability and cost-effectiveness. In combination, these elements determine whether the power source chosen for an ICT initiative is fit-to-purpose for the project in hand.

Projects which provide innovative sources of power to areas with poorly developed or non-existent infrastructure may therefore often rely on renewable sources of energy but provide two or three alternatives as back-up to the main source of power. In some cases this source may be marginally more expensive than mains electricity but if it extends the reach of a project it is judged worth the additional investment.

In many cases, however, such provisions are not built into the initial design or development of ICT4D initiatives and if they are not added in later have the potential to impact upon the sustainability of an initiative. In many cases, using renewable sources is a more feasible solution to guaranteeing power supplies for ICT4D, as well as promoting environmental sustainability in the long run.

The final key lesson with regards power is that of cost-effectiveness. Affordability serves as a constraint for projects like the B2B Commerce initiative in the Philippines where electricity connection rates are relatively high in comparison to most developing countries. Equally, a project such as the Equal Access Foundation whose radios require 10 AA size batteries in order to function, suffer from a constraint in terms of cost, access, flexibility and sustainability. Finding a solution which meets initiatives power needs without raising costs beyond the means of the majority of consumers is vital.

Hardware

Introduction

Hardware forms another key infrastructural element of the ITAFE framework which must be considered closely in order to develop a successful ICT4D initiative. The chosen hardware must be fit-to-purpose not only in its ability to run the relevant software and applications but also its compatibility with an initiative's power and connectivity capabilities. ICT4D initiatives tend to use or adapt existing hardware or develop new hardware for their purposes and each approach attracts different costs and complexities.

Types of hardware

The types of hardware used by ICT initiatives tend to be generic and based upon handheld, mobile or static devices available on the market, primarily because of the costs associated with developing new hardware in relation to the benefits gained. Each initiative will, however, select the hardware used according to the needs of the vertical in which the initiative operates and the suitability of the respective hardware to that initiative. Few initiatives included in the ITAFE

10 http://www.jhai.org

ITAFE Matrix

matrix have undertaken the expense of developing new hardware for their purposes, with the majority choosing instead either to use or adapt existing hardware. Focus thus far has tended to be on PCs, PDAs, mobile and land phones as the main hardware for projects with supporting hardware such as satellites, solar panels and wallsets used for connectivity. As with the options for power supply, the list of hardware described below is not exhaustive but a representation of the individual types and combinations which tend to be favored in ICT4D.

Mobile and static phones

One of the simplest and most effective solutions harnessed by ICT initiatives are mobile and land-line phones. Globally there are now over 1.2 million main telephone lines and 1.4 million mobile cellular subscribers.[11] Public and personally-owned land-lines phones are often part of the existing infrastructure and are well understood by users. In many developing countries, the growth of mobile phones in the last five years has been exponential and handsets can now be obtained at relatively low-cost.[12] Mobile phones offer a particular benefit to ICT initiatives in the form of Short Message Services (SMS) which can provide information and facilitate communication at very low cost to both the service provider and recipient.

Despite growing uptake, mobiles remain particularly scarce in remote or poor communities. In some cases this fact may increase their commodity value and make them extremely vulnerable to theft. However, in many cases shared usage models are applied which are reliant on societal interconnectedness and interdependence and mean that one phone can provide benefits to whole groups within a community. Shared usage models using both static and mobile phones can be used to promote entrepreneurship and keep expenditure on hardware for ICT initiatives to a minimum.

Handheld Devices

Handheld devices offer a mobile solution which provides the same basic connectivity as mobiles but with a more sophisticated user interface and information-rich software. They can therefore be used for projects as varied as providing IT support to operating as a diagnostic tool between nursing staff in remote villages and doctors in health-clinics. Significant advancements over the past ten years in the development of PDAs and handheld devices have also lowered their price, making them more affordable for many individuals. Their cost remains a constraint however as do the languages and settings to which they are predominantly configured and which exclude users who are either illiterate or do not speak internationally-used languages.

PCs

The PC remains one of the most significant pieces of hardware used by ICT initiatives because, where the correct connectivity is also in place, it offers the simplest method of accessing a wealth of information through the web and offering multiple users access to transferable IT skills. In this respect, PCs have been of particular value to educational establishments, whose equipment in turn is often utilized to promote the use of ICT within the broader community. As with handhelds, constraints exist for illiterate or local language users although these can be overcome if the relevant local language and graphic software is accessible and affordable.

However, levels of PC ownership in the developing world remain low. Globally only 650 million people have PCs.[13] In the developing world, figures average at about 1/100 people in developing countries but can be as high as 8/100 in Argentina or as low as 0.18/100 in Burundi.[14] Basing ICT4D initiatives on PC usage therefore requires that the hardware is sourced imaginatively, for example the recycling of computers from the developed world, and that their value and usage is maximized across the community including schemes for ICT capacity-building.

Kiosks and Telecentres

For a number of initiatives the benefits of the PC have been expanded by shared-usage models

11 Source: 2003 forecast, International Telecommunications Union available online

12 In countries like Kenya the exponential growth in mobile phone ownership over the last 10 years, from close to 0 per 1000 people in 1996 to 19 per 1000 in 2001 (World Bank factsheet, 2003), a total of 200,000 subscribers to in 1999 to 2m in 2004 (Safaricom and Kencell data) means that ownership of mobile phones now outstrips landlines by 2 to 1.

13 Source: 2003 forecast International Telecommunication Union (ITU) available online at www.itu.org

14 Source: 2003 figures, ITU factsheet, November 2004 – available online.

such as telecentres and kiosks. In some cases, these models are little more than a group of PCs, servers, printers etc which can be accessed by multiple users over a period of time but which provide the benefit of an individual log-in that allows users to maintain their own email accounts and store files. In more sophisticated cases, such as the DrumNet kiosks in Kenya, a simplified GUI is specifically developed for the initiative which enables access to a kiosk for illiterate and local language users.

Radio

Another shared usage model, albeit one which has been in existence far longer than telecentres and kiosks, is the radio. It operates predominantly self-sufficient of software and applications and, whilst extremely simple and prevalent in the developed world, can provide immediate access to news and education for many people living in extremely remote areas of the developing world who have no alternative methods of accessing such information.

Future options

The future for hardware in the area of ICT4D is closely linked to ongoing developments in the wider world of technology. Developing world consumers want the same solutions as developed world consumers but in many cases have far more to gain from accessing information available on the internet and from developing IT skills. The continued development of thin client shared-usage models, smart mobiles, tablet PCs and more advanced mobile phone solutions and a concomitant decrease in prices, will all enable ICT initiatives to take advantage of better, more affordable and more efficient technology as it emerges. HP, for example, has developed the 441 PC that can be set-up in schools or libraries, which connects four keyboards and four screens through one PC so that multiple users can access the Net or send e-mail at the same time.[15]

More advanced mobile phone hardware also offers a number of new opportunities for ICT initiatives in terms of the potential to improve service, content provision and reach. One such example would be the possibilities which GPRS, General Packet Radio Service, phones offer in the provision of informational services as they become more readily available in developing countries. GPRS is a non-voice value-added service that allows information to be sent and received across a mobile telephone network, supplementing today's Circuit Switched Data and SMS services. GPRS has a considerable impact on the speed and efficiency at which information can be transmitted between phones, bringing down the cost of internet connectivity via mobiles. It would allow initiatives to provide graphic texts for illiterate users and offer considerable scope for services such as automation and money transfer which would potentially be very valuable to remote communities. At present, however, GPRS phones are either too expensive or simply unavailable in developing world markets.

Beyond GPRS, the next step which will expand opportunities for ICT4D initiatives will be the enablement of wireless solutions through 3G phones. As 3G licenses begin to be granted in some developing countries, wireless solutions will spread accordingly. Asia, for example, now has 30 million PCs compared with 200 million cell phone users who, as of 2004 will be able to purchase 3G phones capable of handling e-mail and Web surfing.[16] Such developments change the relative benefits of choosing a particular hardware option for an ICT initiative. Taking advantage of these developments will require combining ICT initiatives in the developing world with the creation of new, more advanced solutions for developed world consumers, rather than viewing hardware requirements for ICT4D initiatives as existing separately from the consumer-driven developed world.

Criteria for assessing hardware

Despite advances in the possibilities which hardware opportunities offer, the central criterion which applies to the choice of hardware chosen continues to be that it is fit-to-purpose. As a key element of the infrastructure of ICT initiatives, the hardware used is often predetermined by the project's purpose. In addition to this it must also be affordable, compatible with the existing or proposed infrastructure, usable, reliable, efficient and secure.

Affordability

One of the key elements for judging the success of the hardware used by ICT initiatives is affordability. Hardware is not only a key element of the

15 Business Week "Tech's Future", September 27, 2004, www.businessweek.com/magazine/content/04_39/b3901013.htm

16 ibid

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set-up costs of such initiatives but will determine the ongoing maintenance costs and the likely cost of training and support. For this reason, it must be fit-to-purpose and provide a flexible solution without being overly complex. Solutions which can rely on existing landline phones for example should do so in order to avoid outlay on unnecessary hardware and maintenance costs. In contrast, it will become more cost-effective to use hardware such as PDAs as prices fall and availability increases and this fact should be exploited as far as possible. Ultimately, the set-up and maintenance costs of an initiative's hardware will have a vital impact on its sustainability and scalability.

Infrastructure requirements
As discussed in detail in the section on power, another key element in assessing the success of the hardware used by ICT initiatives is to understand the compatibility between the chosen device and the various infrastructural elements required to make it function to its fullest capabilities. Hardware must, for example, be able to run using the available power supply and, where connectivity is required, be compatible with the solutions available. It must be suitable not only for the existing infrastructure but given future trends in power supplies and connectivity.

Usability
The concept of usability extends from compatibility with existing infrastructure to the question of ease-of-use. Take-up rates on hardware, and its likely adoption and local buy-in will be closely linked to how usable the system is in terms of the technical skills and the level and provision of training required to operate it, as well as its visual appeal and the possibility of shared usage. Usability is a key area where an initiatives' technological infrastructure links closely with human capacity development in the form of training and support to ensure the success of an ICT initiative.

Reliability
Usability is also linked in to the reliability of equipment. The requirement for maintenance and repairs is a key element for consideration when designing an ICT initiative around a hardware solution. Equipment which is very difficult to repair and maintain can be next to useless in remote areas whereas equipment which can easily be supported by local people with a reasonable level of training offers opportunities for existing projects and for ongoing IT capacity development. Equally important is the availability of spares and the supply chain for equipment. If feasible, the use of local suppliers reduces the likelihood that hardware will fall into disrepair and also increases the benefits received by the local community from an ICT initiative.

Efficiency and environmental impact
In order to further ensure that ICT initiatives benefit the local and wider communities, the use of efficient, environmentally-sound hardware is also an important consideration. For most ICT initiatives there is scope to use hardware designed either with reduced power requirements, compatible with renewable sources of energy or which can be recycled or disposed of responsibly at the end of its lifespan.

Security and ongoing development
A final consideration when assessing ICT4D initiatives is the likelihood of misappropriation of hardware or eclipse by new technology. Security requirements may be high in models such as shared-usage telecentres, which local business people are reliant on to run their enterprises. Equally, where disease surveillance or other key health information is being relayed the security of the data is a key element in assessing the reliability of the solution. The risk of eclipse by new technology may, in contrast be much harder to address. Whilst irrelevant in contexts where a simple hardware solution forms the basis of an initiative and meets the requirements adequately, it becomes more of an issue where solutions are based on high-technology hardware at risk of quickly becoming obsolete and representing a high cost to benefit solution for an ICT initiative.

Devising solutions

Finding the best-fit hardware for an initiative which meets the other criteria listed above results, in practice, most frequently in solutions based on the use or adaptation of existing hardware. In the majority of cases, it is more cost-effective for technology producers, whether based in developing or developed countries, to bear the cost of developing new hardware, whilst ICT initiative focus on using that hardware creatively and maximizing its potential.

ITAFE Matrix

Uconnect, Uganda[17] and CDI, Brazil[18]

Criteria	Score
Affordability	4
Compatibility with infrastructure	5
Reliability	5
Usability	5

The benefits of using existing hardware are evident in a number of projects akin to Uconnect in Uganda or to CDI in Brazil. Both initiatives have reused computers discarded by developed countries, corporations etc, recycled them and adapted them for use in schools and by local business people. The majority of the costs associated with this process are in the shipping but both initiatives have set up sponsors of the program who enable these costs to be significantly reduced. The actual recycling of the computers is low cost and can be kept low if license agreements with software companies can be reached.

Bridgeit/text2teach, Philippines[19]

Criteria	Score
Affordability	3
Compatibility with infrastructure	5
Reliability	5
Usability	5

The imaginative combination of a number of different forms of existing hardware can also produce innovative results for ICT initiatives. The Bridgeit/text2teach project uses satellites, mobile phones, videos and TVs to transmit educational videos from Pearson to schools in the Philippines. The hardware itself is used as designed for the commercial market but it is the use to which the hardware is put, in combination with the connectivity solution, which is innovative.

Voxiva Alert, Peru[20]

Criteria	Score
Affordability	5
Compatibility with infrastructure	5
Reliability	5
Usability	5

Adapting existing hardware can also have significant results. The Voxiva Alert initiative in Peru uses landlines but has adapted them to create a voicemail and reporting system. Users have individual, virtual voice accounts which are easy-to-access and allow them to make reports and exchange peer-to-peer information. The initiative is differentiated by its creative use of hardware that is simple, widespread and easy-to-use making the resultant solution an immediate success both in Peru and globally.

Jhai Foundation, Laos[21] and Freeplay Foundation, Africa[22]

Criteria	Score
Affordability	4
Compatibility with infrastructure	5
Reliability	5
Usability	5

However, overcoming more significant constraints such as climatic extremes or remote locations can require a solution based around the development of new hardware. The Jhai PC, developed in the US for use in Laos,

17 http://www.uconnect.org/

18 Info dev Annual report 2003 http://www.infodev.org/library/AR/2003/annual03pt1.pdf

19 http://www.unescobkk.org/education/ict/v2/detail.asp?id=11184
www.ayalafoundation.org/news.asp
http://www.iyfnet.org/document.cfm/39/634
http://press.nokia.com/PR/200406/950416_5.html

20 Michigan Business School - December 2003 http://www.bus.umich.edu/BottomOfThePyramid/Voxiva.pdf
InfoDev 2003http://www.sustainableicts.org/infodev/Voxiva.pdf
C.K.Prahalad (2004) The Fortune at the Bottom of the Pyramid, Wharton School of Publishing

21 http://www.jhai.org

22 http://www.freeplayfoundation.org

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was specifically designed to overcome high temperatures, dust and humidity. Similarly the Freeplay Foundation's Lifeline radio was specifically designed for use in tough conditions and to require limited maintenance. With this aim, and ease of use, in mind, it features an aerial which is replaceable with a simple piece of wire if broken, a rainbow-shaped dial and easy-to-read features and can be specifically built to meet customer needs.

Simputer, India[23]

Criteria	Score
Affordability	2
Compatibility with infrastructure	5
Reliability	5
Usability	4

Not all developments of new technologies serve their purpose as efficiently as the two examples above however. The Simputer, developed in India, exemplifies the dangers of over-engineering a solution, and viewing a development initiative in isolation from the wider market, when existing hardware could have been used with the same result. Although the Simputer is more powerful than a PDA and has SmartCard facilities which enable shared-usage, it is not sufficiently differentiated to persuade customers that it is worth its current price of four times that of a PDA. Its main feature is local language software and graphic software for illiterate users which could be extremely useful in a development context. To date, however, the company behind the Simputer has been unwilling to separate hardware and software and as a consequence, uptake of the product has been limited.

Key lessons

Hardware usage in the examples researched to develop the ITAFE matrix indicate that the equipment required for many ITAFE initiatives is predominantly based on the use or adaptation of existing technologies, including the recycling of equipment. Only in a few cases, particularly when trying to reach more remote areas, is there benefit in significant investment in the development of new technologies.

One of the reasons to support the use or adaptation of existing technologies is the fact that set-up and maintenance costs for hardware can constitute a significant constraint on ICT initiatives. This constraint is more easily overcome where projects are sponsored by corporations who provide the equipment, as might be the case for the e-Choupal kiosks or for Grameen Phones but is more complicated for smaller scale projects with lower budgets who may more efficiently rely on using hardware already available in the target market. Otherwise the constraint may be two-fold both in terms of a lack of availability of equipment in the locale and the cost of purchase and/or shipment from another location. Once the equipment has reached the initiative in contrast, the emphasis must be on reducing constraints linked to its usage in terms of connectivity, the applications and software it runs, how it is powered and how users are trained and supported.

Connectivity

Introduction

Connectivity forms another key element of the technological infrastructure on the supply side of the ITAFE matrix. Reliable, sustainable and cost-effective connectivity, whether that be to the Internet, landline or mobile phone networks, is essential for the majority of ICT initiatives. However developing countries, particularly remote areas, often lack the infrastructure to provide cellular networks or internet access in addition to facing regulatory constraints around the licensing of networks and access to competitive connectivity options. In a global population of 6.3bn there were only 1.2 million main lines in use in 2003 and 650 million Internet users[24]. In the developing world, these users are concentrated in urban areas where the infrastructure is in place to provide access and are most likely found amongst a social class who are able to afford the hardware and the cost of a monthly subscription required to get connected. In order to broaden reach across developing countries and into poorer rural areas and informal settle-

23 http://www.amidasimputer.com/media/
http://www.simputer.org

24 Source: 2003 forecast, International Telecommunications Union

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ments, ICT4D initiatives therefore need to focus as much as possible on developing or using imaginatively existing infrastructure or technologies which overcome geographical, socio-economic and regulatory constraints to connectivity.

Connectivity options

Connectivity options for ICT initiatives can be divided broadly into those reliant on traditional wire and cellular networks and those reliant on satellite technology. In some cases the most successful projects are those that use a combination of a number of sources.

Wire (Public Switched Telephone Network)/ Fibre optic solutions
Wire and fibre optic technologies are traditional sources on which the majority of landline telephone networks in developed and developing countries are based. Teledensity, as the total number of fixed lines per 100 of the population is referred to, is growing in the developing world[25] but often today at a slower rate than the growth of mobile subscribers for example. Wire lines are often controlled by the government and a failure to deregulate acts as a constraint for many initiatives as do the physical limitations placed by wire and fibre optic networks which restrict access to more remote areas. The combination of these constraints means that many ICT initiatives seek alternative connectivity solutions which enable greater flexibility, and speed and volume of traffic.

Cellular/WLL (Wireless Local Loops)
A more accessible connectivity solution for many remote areas is cellular or wireless local loop systems, which also offer faster connectivity at a cheaper price. Wireless technology provides the basis for mobile phones across both developed and developing countries and both extensive reach and reduced dependency upon government-sponsored access to traditional networks. Most importantly cellular networks reduce dependency upon physical infrastructure which is good news for remote and poorly served areas that many ICT initiatives aim to reach.

Satellite/VSAT (Very Small Aperture Terminal)
The most flexible connectivity solution currently available is based on satellite technology. In a number of initiatives this provides remote areas with the capability to connect with and distribute information via satellite from places as far away as the US. Satellite technology also enables connection to radio stations and in some cases the downloading of digital information. The scope of opportunities which satellite connectivity offers to services such as Global Positioning System (GPS), a free-to-use global network of 24 satellites run by the US Department of Defense which allows users to receive their satellite position as well as send and receive data quickly has already been exploited successfully by initiative aimed at remote users. Overcoming the cost and infrastructural requirements of satellite reception would allow more initiatives to benefit from such services.

Combination options – Wire/VSAT/WL
For many of the ICT initiatives included in the ITAFE matrix, the most flexible connectivity solutions are those that combine a number of different options, increasing the likelihood of a connection and its reliability. Such combinations allow initiatives to base their connectivity on telephone lines for example but to install VSAT links which will expand the initiatives' reach and flexibility. Combinations of connectivity options allow initiatives to overcome existing infrastructural challenges and are often key to transitioning projects towards scalable solutions.

Future sources of connectivity
At present the use of satellites for connectivity in ICT4D projects is the most flexible solution available for remote areas and for covering large distances. However, the use of satellites is currently constrained both by the availability of the hardware and the cost of the solution. Over time it is hoped that such problems will be overcome as the technology becomes more widespread and costs fall. The spread of GSM (Global System for Mobile Communication) networks across regions such as Africa will also prove key to the spread of availability of cellular networks.

The spread of GPRS and 3G across developing countries is also likely to offer considerable connectivity opportunities to mobile phone and internet initiatives. As discussed in the hardware section, GPRS, Global Radio Packet Service,

25 Developing countries now account for almost half (49%) of total telephone subscribers in the world, up from just 19% in 1990 (Source: Ch 4, ICTs and the Millennium Development Goals, World Telecommunication Development Report 2003, ITU

facilitates faster, more immediate transmission of data than fixed telecommunications networks and Circuit Switched Data services in GSM networks. The immediacy of the service has significant potential for reducing the cost of internet connectivity, for applications such as remote credit card authorization, for the transmission of still and moving images, document sharing and collaborative working and for the growth of other features such as remote access email and positioning systems.

However, as discussed, it requires users to own a mobile phone or terminal that supports GPRS and mobile network operators to enable the system for users. Additional limitations such as the requirement for an Internet addresses rather than another mobile phone to receive and send information through GPRS or that, at the moment, GPRS does not support point to multipoint services which would hinder the distribution of a single message to a group of people, are likely to hinder initial uptake in the developing world context.

In the longer-term it is likely that GPRS will be overtaken by 3G services provided that the infrastructure required is in place and that licenses are granted by the government or relevant incumbent. However, the limited success of 3G in developed world contexts indicates, for example in Europe where it remains only 3% of service provider revenues[26] and considerable infrastructural constraints in the developed world context, mean that this may not become a major consideration for ICT initiatives for some time.

Criteria for assessing connectivity

There are numerous options available for the connectivity of ICT initiatives, some of which, like using landlines, rely heavily on existing infrastructure but at a low-cost and some of which, like satellite technology, offer extensive reach but at a considerably higher cost. The balance in this case for any ICT initiative must be between finding a solution which maximizes existing connections cheaply or reaches out to many more users but at a greater cost.

Affordability
In order to achieve this balance a key consideration in assessing the success of connectivity in ICT initiatives has to be affordability. Projects that piggy-back on existing systems are likely to be much more affordable that those which are reliant on satellite technology although in the long-run they may be less successful. Affordability for individual users is also important. The cost of connecting to the internet in remote areas can be prohibitive to the uptake of an initiative.

Infrastructure
A key element which impacts upon affordability is the use of existing infrastructure versus the creation of new infrastructure. ICT initiatives must asses which is the best solution based on the what infrastructure is in place, what the minimum connectivity requirements of the ICT initiative are, the population density which connectivity must support and the power supply available.

A central part of this decision-making process will therefore be the intended reach of the project. Where remote areas are being accessed, the distance from the network connection or the existence of satellite receivers are key considerations which are much lesser concerns in urban areas.

Telecommunications regulation and liberalization can also be included as an infrastructural constraint or facilitator for ICT4D initiatives. Policy reforms which enforce the end of monopolies, and potentially facilitate a competitive market with pressure on service provision, are advanced in many developing countries[27] although only recently underway in others.

Usability
Cost and the existence or creation of connectivity infrastructure are, therefore, important considerations. However it is worth recognizing that although costs can be reduced by using wire or fibre optic technology this may also have a dramatic impact upon the usability of a solution by reducing the reach of an initiative, the speed of a connection or meaning that connectivity is not possible at all. Hence the high-levels of uptake of broadband services in developed world contexts.

26 FT online "3G – content provider's perspective. Big challenge as interests collide" Nairn Oct 20, 2004. Available online

27 The World Economic Forum's Consultation report on Southern Africa for example lists Botswana, Mauritius, South Africa and Zambia as examples of advanced countries in terms of policy reforms to end monopolies in telecommunications. Source WEF: "Southern African Development Community – World Economic Forum Consultation Report on e-Readiness" 2002

ITAFE Matrix

Reliability
ICT initiatives must also be assessed based on the reliability of their connection, which will vary according to the technology which underlies them and the level of maintenance which is expect and support required. Where projects are focused on Internet connectivity, it is important that connections are as reliable and secure as possible. This can be constrained by the number of ISPs on offer which, as with network providers, has in many developing countries often historically constrained by government-ownership of the telecommunications infrastructure. For all forms of connectivity, the reliability of the solution is essential to ensure that data is not lost and that a secure connection is upheld.

Devising solutions

Connectivity solutions for ICT initiatives choose are therefore designed using the options and criteria described above. In many cases, constraints on connectivity require initiatives to combine harnessing existing infrastructure with innovative solutions to ensure an affordable, reliable and usable solution which fits the infrastructure available.

Voxiva Alert, Peru[28]

Criteria	Score
Affordability	5
Reliability	5
Usability	5
Fit to infrastructure	5

The Voxiva Alert initiative in Peru is one example of the former approach, using the existing landline telephone network in conjunction with Internet access to provide disease surveillance which users access either through dialing a free phone number connected to a secure server or by entering their information over the internet. Reports can be received via email, voicemail or SMS and users can communicate with each other peer-to-peer using voice mail. The solution rests on existing technology but uses a number of different solutions to ensure maximum coverage and reach.

Grameen Phone, Bangladesh[29]

Criteria	Score
Affordability	4
Reliability	4
Usability	4
Fit to infrastructure	5

Constraints in the form of government legislation can also be overcome through the imaginative use of existing infrastructure. Grameen Phone's method of overcoming lack of access to a monopoly-owned cellular network have been to negotiate with Bangladesh Railway's to lease their high-capacity fibre-optic digital transmission network which has been laid beside the railway tracks and which covers an extensive area of Bangladesh. Only in areas without fibre-optic infrastructure, such as the southern coast, has GP built microwave links. The advantages that the breadth of this network provides are vital because the majority of Grameen phones now operate within the network and not between the network and fixed-line telephones. Grameen Phone has been additionally constrained by the use of cellular technology for fixed phone centres because GSM systems are far more expensive than the fixed wireless local loop (WLL) systems used by the companies competitors, have 10 times less coverage and provide poor bandwidth for data transmission.

28 Michigan Business School - December 2003 http://www.bus.umich.edu/BottomOfThePyramid/Voxiva.pdf
InfoDev 2003http://www.sustainableicts.org/infodev/Voxiva.pdf
C.K.Prahalad (2004) The Fortune at the Bottom of the Pyramid, Wharton School of Publishing

29 World Resources Institute 2001 http://www.digitaldividend.org/pdf/grameen.pdf
http://www.grameen-info.org/grameen/gtelecom/

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Manobi, Senegal[30]

Criteria	Score
Affordability	3
Reliability	5
Usability	4
Fit to infrastructure	5

The Manobi project in Senegal, operating on a much smaller scale and in a far more difficult operating environment[31] has also opted to maximize its connectivity options but focuses predominantly on the innovative use of satellite technology to reach remote areas. Manobi operates a multi-channel service platform through WAP, SMS, MMS, I 'mode and the Internet. The system relies on satellite technology (GSM) which is much cheaper in this case than building fixed infrastructure and which can be coupled with GPS systems for the provision of real-time information to remote customers such as fishermen.

African Virtual University, regional[32]

Criteria	Score
Affordability	4
Reliability	5
Usability	5
Fit to infrastructure	5

Where satellite technology is feasible, it provides probably the most versatile solution to connectivity problems in developing countries. In the case of the African Virtual University (AVU), for example, VSAT technology has been provided by one of the project's key partners, Netsat, and has proved vital for overcoming technological and infrastructural constraints. Lectures are transmitted to AVU's central uplink facilities in the US and transmitted to learning centres across Africa. VSAT technology therefore provides a cost effective solution to the geographical dispersal of sites. However, it requires the existence of receiving and transmitting technology which can be expensive.

n-Logue, India[33]

Criteria	Score
Affordability	5
Reliability	5
Usability	5
Fit to infrastructure	5

A more cost effective solution in many cases is the use of wireless technologies, which provide higher bandwidth at a lower cost. n-Logue kiosks use a fixed WLL solution, corDECT, to provide voice, voice band fax/data transfer and Internet connectivity at up to 384kpbs when digitized. Coverage in this case can be extended up to 25km using a repeater and the solution provides a relatively cost-effective means of connecting remote areas without the need for building extensive infrastructure.

Key lessons

Constraints to connectivity include infrastructure, cost[34] and government policy and can have a significant effect on projects which are reliant on the Internet, mobile phones or landlines in order to provide education, economic or health-based solutions. Many ICT initiatives are impacted

30 http://www.digitaldividenetwork.org/content/news/index.cfm?key=760
http://www.manobi.net/index.php?M=1&SM=1&lang=en
http://www.alcatel.com/sustainable/fracture/fracture5.htm

31 Only 25% of the Senegalese population has access to electricity for example and an estimated 54% of households live below the poverty line (Source: N. Murooke 2004, Role of Infrastructure in Economic Growth and Poverty Reduction – Lessons learned from PRSPs of 33 countries. OECD conference, Berlin, 27-29 October 2004)

32 http://www.itu.int/osg/spu/wsis-themes/ict_stories/AVUcasestudy.html

33 July 2001 World Resources Institute http://www.digitaldividend.org/pdf/nlogue.pdf, http://www.n-logue.com/
M.L. Best & C.M. Maclay. Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle. The Global Information Technology Report 2001-2002:Readiness for the Networked World. Oxford University Press. 2002.
R. Kumar, A. Jhunjhunwala. Taking Internet to Village: A Case Study of Project at Madurai Region. MIT. 2002.
C. Blattman, R. Jensen, R. Roman. Assessing the Need and Potential of Community Networking for Developing Countries: A Case Study from India. 2002.

34 In 2001, PC ownership in India was 5.8/1000 people and there were 7,000 internet users. In a country where 35% of the population live on below $1 per day and the GNP per capita is $480, the costs of internet connectivity, for example, $10 per month for service provision and $0.18 per month for telephone usage, are prohibitive.(Source: World Bank factsheet 2003)

either by a lack of infrastructure in place to provide phone networks or internet access or the fact that the existing infrastructure does not have sufficient reach to provide access to the remotest, and often the neediest areas. The installation of connectivity infrastructure can be beyond the means of many ICT initiatives, an issue which is particularly pertinent for satellite technology.[35]

The most important lessons which emerge from studying the connectivity constraints faced and solutions devised by ICT initiatives across the ITAFE matrix are that, as with the provision of power, the best-fit solutions are those that maximize existing infrastructure and where possible utilize flexible solutions such as wireless or satellite technology. Success can therefore be achieved at two ends of the connectivity spectrum, by using extremely simple landline technology as is the case for Voxiva in Peru and in projects such as the AVU or Manobi which use VSAT technology for extensive reach and high-speed connections. Flexibility is also a key issue for overcoming both infrastructural constraints and the issue of restrictive government regulation.

Software and Applications

Introduction

The software and applications used by the ICT initiatives constitute the final technological element of the ITAFE matrix and are designed as an interface between technology and users which meets the requirements of a specific vertical, such as education, health or economic opportunity. On the whole, different verticals provide ample opportunities for a variety of software solutions but tend to suffer from similar constraints. Overcoming these constraints requires a clear understanding of the criteria under which software and applications in ICT initiatives are successfully used, which includes their fit to user requirements, the available technical infrastructure and the usability of the solution. The design of an initiative's software and applications and their fit-to requirement are essential to ensure success, sustainability and scalability.

Software and Application options

All ICT initiatives, irrespective of their scale and the hardware in use, require some form of software or application in order to operate. Whether internationally recognized and licensed or open-source, an initiatives' software or application is often the most user-specific element of the initiative. As the interface between the user and the ICT solution, it therefore requires the most design and planning in order that the specific requirements of the vertical it serves are met. The principle verticals for software and applications to support which were investigated by the ITAFE matrix are education, economic opportunity, health, environment and empowerment and participation. It is recognized that additional verticals exist, but the focus for the ITAFE matrix are those considered to have the greatest potential for developmental impact and the involvement of the private sector.

Education
The primary benefit of ICT for educational initiatives is the wealth of information and learning materials which technology enables them to access. The software and applications which support this aim are key in the provision of access to education materials, the internet and e-learning tools, the creation of inter-school networks and the use of ICTs to improve process efficiency in schools. Whilst all software and application requires the correct design and configuration where it aims to reach a mass, diverse audience with the aim of education this is especially important. Given the breadth of information available, the potential for ICT initiatives to enhance education in developing countries in enormous but this can only take place where the software and applications used are usable as possible.

Economic Opportunity
Access to information is also key for the promotion of entrepreneurialism, The provision of market information, job opportunities or e-trading can all serve as a means of elevating bottom of the pyramid farmers or business people and enabling them to improve their operating margins and profits. Just as businesses in the developed world are reliant on an understanding of their

35 ITC's decision, for example, in supporting the e-Choupal initiative to move towards VSAT technology in order to enable a better throughput of information (256Kbps as opposed to 40Kbps through telecom infrastructure) costs US$2,560 per installation.

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competitors and the markets they operate in, so too do developing world businesses benefit from making informed decisions to improve their strategies and processes. The software and applications which enable users to access this information are therefore critical. As in education, they must overcome constraints of illiteracy or unfamiliarity with the traditional internet languages if they are to meet the requirements of the market in which they operate.

Health
The software and applications which support ICT initiatives focused on health are designed to promote access to and the dissemination of information as well as the increased proficiency of reporting and diagnostic processes. Designing usable interfaces for users in remote areas, for example, enables linkages to remote health services and other clinics which not only promote efficiency but have the potential to save lives.

Environment
The benefits for environmental initiatives of using ICT lie in the facilitation of awareness and understanding of environmental impact, encouraging cross-border participation through networking, and the spread of lessons about beneficial processes, management ideas and cooperative resource management. As for the other verticals, the key benefits of ICTs in this area are in the access to information, the ability to share information, and to communicate with previously inaccessible individuals and communities. For remote areas under environmental stress, such access can be key to publicizing the benefits of environmental management and the problems faced by particular communities. Supporting all of these aims are software and applications which enable information management and operate as tools for the sustainable management of natural resources. In some cases these can be developed specifically for the initiative but the use of generic word-processing or spreadsheet packages can equally provide a platform for sharing information.

Empowerment and participation
In both developed and developing world contexts the possibilities of using ICTs as a means to improve participatory processes and promote good governance have also expanded considerably over the last ten years. Both as a means to regulate and improve the transparency of elections, or to promote information sharing and provide community services, ICT initiatives offer benefits which go beyond financial efficiency. Access to information via the web can broaden individual's horizons, better people's knowledge and understanding of political, social and economic issues as well as providing a means of highlighting the work of local initiatives to a global audience. One particular area of empowerment is gender. Access to information across borders offers women, in particular, networks for empowerment, virtual communities for support, access to training and support modules and the ability to develop strategic international alliances.

Criteria for assessing software and applications

The software and applications used by ICT initiatives must therefore serve a broad variety of verticals and within those verticals a number of different purposes. Despite their differences however, they can all be assessed by their ability to meet user requirements and to do so in an affordable and sustainable manner and in line with available infrastructure options.

Applicability
The applicability of a software or application solution determines how well it fits user requirements, the hardware on which an initiative is based and other applications with which it must work. Successful solutions are those designed with specific user requirements in mind but which are also flexible should new uses be built into an initiative or new hardware or devices introduced. It is not only the content of software or application which determines its applicability but also the languages and graphics which it supports and which make up the user interface.

Affordability
The cost of software and applications is a key element of any initiative. The provision of licenses encompasses both a one-off and ongoing maintenance costs which can often be prohibitive for small-scale initiatives. Solutions which are affordable are also more likely to be sustainable, scalable and reliable. Initiatives must bear in mind that offers of reduced price software or licenses, whilst compelling in the short term, may not be

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ongoing and may affect an upward trend on the costs of software and application provision which ultimately constrains the project.

Infrastructure
All software and applications will have specific hardware, power and connectivity requirements in order to function correctly. The infrastructure of the initiative therefore needs to be understood and designed from a holistic viewpoint in order that the best-fit solutions infrastructure is to be put in place.

Usability
In conjunction with applicability, affordability and infrastructural needs, it is the usability of software and applications which will determine its ongoing use. This factor works in conjunction with the provision of training and support to ensure that users of varying skill levels, and often with no previous IT experience, are able to get the most out of the applications and software used by ICT initiatives.

Devising solutions

The most successful solutions in the provision of software and applications for initiatives are those that successfully balance the need for affordable solutions with software that meets specific user requirements and is compatible with the infrastructure in place.

African Virtual University, regional[36]

Criteria	Score
Applicability	5
Affordability	4
Fit to infrastructure	5
Usability	5

In some cases the prohibitive cost of licensing software and applications is overcome through sponsorship from the software company itself or from a donor related to the ICT initiative. AVU, for example participates in the Microsoft Academic Volume Licensing agreement designed to reduce costs of acquiring, upgrading, maintaining and managing software for multiple computers which allows AVU to equip all of their learning centres with Microsoft products.

Jhai Foundation, Laos[37]

Criteria	Score
Applicability	5
Affordability	5
Fit to infrastructure	5
Usability	5

In direct contrast, another method of tackling both cost, licensing and access constraints is to use open-source software in local languages. This is the approach adopted by the Jhai Foundation to work in conjunction with the Jhai PC in remote areas of Laos, providing access to the Internet for schools and businesses. The Jhai PC runs on a Laos-language version of the free, Linux-based KDE graphical desktop and runs Laos-language office tools.

Uconnect, Uganda[38]

Criteria	Score
Applicability	4
Affordability	5
Fit to infrastructure	5
Usability	5

A key consideration for software and applications is that they fit the requirements of the project and are not excessively complex to meet the solution. Uconnect in Uganda, for example, runs on Windows 95 software installed on PCs. The software is very slow but is considered more user-friendly by the initiative than more up-to-date versions.

36 http://www.itu.int/osg/spu/wsis-themes/ict_stories/AVUcasestudy.html
37 http://www.jhai.org/economist.htm
38 http://www.uconnect.org/

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n-Logue, India[39]

Criteria	Score
Applicability	5
Affordability	5
Fit to infrastructure	4
Usability	5

Another important consideration for ICT initiatives is that the software and applications they use are accessible to individuals who are illiterate or who do not speak international languages in which such technology tends to be configured. The n-Logue project, taking these constraints on board, uses local language software developed with a local software firm, Chennai Kaviggal for its word-processing, spreadsheets and email. In addition it runs local language content developed in conjunction with another local partner, Webduniya.com.

Simputer, India[40]

Criteria	Score
Applicability	3
Affordability	2
Fit to infrastructure	4
Usability	5

Another initiative which emphasizes the need for applicable software is the Simputer developed in India. Much of the software available on the application was tailored specifically to meets its key functions and included Doodle n'Mail, motion sensor software which responds to gestures, Indian language software, text-to-speech software and a smartcard reader/writer for integrated identification, sharing and security. The applications were designed in Information Markup Language, which is more versatile than XML, follows internet standards and allows standards to be controlled. However, despite the considerable effort put into the software on the Simputer, there was not enough focus on the end-user in the design of the product, resulting in a higher price than had been anticipated and that was feasible given the existence of PDAs in the market. The software available on the Simputer cannot currently be unbundled from the hardware, meaning the potential winning combination with a PDA has yet to be tested.

Key lessons

The potential for ICT initiatives in this area can be constrained unless the required hardware, power and connectivity are in place to support software and applications. Ensuring that these elements are in place is all part of the holistic approach required to designing and implementing the technological infrastructure of ICT initiatives, which is emphasized by the ITAFE framework.

Even with the right infrastructure in place however, the cost of purchasing and installing software and applications can still be prohibitive. In part this is a problem of licensing, many of which are beyond the means of ICT initiatives. Whilst this can be overcome by the use of open-source software, the resultant solutions may then be constrained in their compatibility with other users as well as reliant upon local technical knowledge for the ongoing support, maintenance and development of their software.

Another major constraint is that the majority of multi-user software which is compatible with hardware and frequently used tends to require both literacy and knowledge of international languages, both of which act as an automatic filter to restrict access. Overcoming the issues of access to software is often vitally important for projects which need to reach audiences in remote areas. Examples such as the e-Choupal and n-Logue kiosks, the Jhai PC and the Simputer have all emphasized the need for local language software in order to meet the needs of the people they are reaching.

Overall, software and applications need to be meet user requirements, be affordable and usable as well as compatible with the hardware

39 July 2001 World Resources Institute http://www.digitaldividend.org/pdf/nlogue.pdf, http://www.n-logue.com/
M.L. Best & C.M. Maclay. Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle. The Global Information Technology Report 2001-2002:Readiness for the Networked World. Oxford University Press. 2002.
R. Kumar, A. Jhunjhunwala. Taking Internet to Village: A Case Study of Project at Madurai Region. MIT. 2002.
C. Blattman, R. Jensen, R. Roman. Assessing the Need and Potential of Community Networking for Developing Countries: A Case Study from India. 2002.

40 http://www.amidasimputer.com/media/
http://www.simputer.org

and infrastructure in place. They form a vital link between the user and technology which makes an initiative usable and therefore ensures uptake and sustainability. Software and applications therefore need to be designed or chosen with care, their purchase and maintenance costs built into an initiative's business model and their hardware, infrastructure and training and support requirements understood as part of an initiative's holistic infrastructure design.

Training & Support

Introduction

Just as technology has been shown to be a crucial component of any ICT initiative, so too is the development of human capacity vital to ensure the ongoing success of ICT4D. Without the required skills to configure, maintain and repair the technology upon which ICT initiatives are based, to support software and hardware and to train users, such schemes have a limited lifespan and are likely to be of limited long-term value to the communities in which they are implemented.

The most successful ICT projects take into account the human capacity and technical requirements for training and support before the project has started. There are multiple options for the design and provision of training and support, from remote access to local services, and both must meet the local requirements of an initiative and be designed to be sustainable. Whilst the limited information available about the training and support of ICT project suggests that it is seldom an area of focus for many organizations, there exist real opportunities in this area to expand IT capacity within and across the recipient population and to create a lasting impression and sustainable business model in the communities impacted upon.

Types of training and support

Consideration of the types of training and support available for ICT initiatives is a key measure of sustainability within the ITAFE framework. Both services can be offered as local or remote services or as a combination of both. The option chosen will be affected by and impact upon the existence and development of IT capacity.

Training – face-to-face
The most traditional model for training is face-to-face (F2F) delivery, whether one-on-one at the site of the initiative or class-room based at a training centre. F2F training is both an efficient and effective method of relaying information from existing to new users that can be further developed by schemes such as "train-the-trainer". However F2F training will be significantly constrained by the availability of staff to conduct training sessions, as well as cost, accessibility to users and infrastructural requirements.

Training – remote
Remote options, in contrast, offer a means to overcome the need for staff on the ground to provide training as well as offering reduced costs when operating at scale. Whether in the form of self-help software or internet-based training, courses which users can access independently, and which can reach multiple users offer a number of benefits. However, by their very nature, they require a prerequisite level of skill which is often absent and for that reason may be unsuitable in areas where basic IT skills do not exist.

Support – local
Support models for ICT initiatives can also be split by those located on the same site as the initiative and those accessed remotely. The primary benefit of locally provided support is also its primary constraint. Projects which are locally supported are likely to be much more sustainable than initiatives where local people have limited knowledge of the equipment on which the project is based. However, developing ongoing support and IT capacity requires willing and capable local people to be trained up to fulfill these roles. This in turn requires that the initiative is willing to spend time and energy to make such an investment in local people.

Support – remote
Remote support, in contrast, relies on nationally- or internationally-based staff in order to overcome the constraints of a lack of local skills and to offer cost-savings through scaled operations. This may in the short-term be a more efficient method of providing support to ICT initiatives. However, it is firstly no substitute for the presence of IT support at the site of the initiative and secondly does nothing to build local capacity, ownership and self-sustainability. Initiatives which receive ongoing support from their corporate sponsors, in the form of technical help, maintenance etc, benefit from a set-up

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which is well-organized and well-trained. However, unless knowledge transfer takes place at the local level, initiatives are unlikely to be of ongoing benefit to a community.

Criteria for assessing training and support

The primary criterion for assessing training and support is, therefore, sustainability. All other criteria upon which training and support are assessed in the ITAFE framework; affordability, reliability and usability, feed into an assessment of an initiative's sustainability.

Affordability

Information on the cost of training is hard to ascertain from ICT initiatives. The most cost-effective methods of training are likely to be face-to-face delivery by operatives on the ground where local training staff can be engaged. Courses carried out away from the location of an initiative constitute a more expensive option. Equally, remote training and self-taught courses all require an initial investment in IT infrastructure in order to function although once set up their cost per user falls considerably. The most cost-effective methods of providing support are also local solutions. Remote support whether by telephone or internet requires a set-up cost and works at scale but may not be appropriate for small-scale initiatives.

Reliability

The reliability of ICT training courses will be essential to ensure that quality training with ongoing benefits is delivered to consumers and users. More importantly, a reliable support model is essential for ICT initiatives to work on an ongoing basis. Whether the requirement is for 24/7 PC support or simply for accessible support over the phone for mobile phone handsets, users need to be sure that the support model is available when required.

Usability

Perhaps the most important element for training options is their usability, Training needs to reach out to individuals with limited IT skills but also to have the capacity to enable users with different skill sets. Whether taught or self-learnt it needs to follow a model to which users can easily adapt and learn and retain the maximum amount of information. Similarly, support and maintenance options need to be usable and accessible. Options such as email-based or telephone help lines are frequently used in the developed world to provide a swift and usable support service. It may be, however, that the most usable solution is in fact one which adopts multiple options for IT training and support in order to make it as viable as possible.

Devising solutions

The key to overcoming constraints to training and support is to build both factors into any initiative as a key element of its start-up and ongoing maintenance.

Uconnect, Uganda[41]

Criteria	Score
Affordability	4
Reliability	5
Usability	5
Sustainability	4

A good example of such an initiative is Uconnect in Uganda. As a condition of the provision of a server, the organization requires schools to undergo the required training to configure and maintain the equipment. Training constitutes a key element of the entire project and those who undergo self-taught training courses are encouraged to train others once they have completed their course. Schools are taught how to maintain and support their own equipment with the intention of promoting a sense of ownership and confidence amongst local staff.

41 http://www.uconnect.org/

ITAFE Matrix

Educ.ar, Argentina[42]

Criteria	Score
Affordability	4
Reliability	5
Usability	5
Sustainability	5

Another vital element of any training and support program is to offer a flexible solution which users can take up over a variety of timescales. In the educ-ar initiative in Argentina, the training model offers capacity-building workshops, TV-based distance learning and virtual campuses as well as distance courses through a portal, all of which users are able to take-up at a time which best suits them.

Grameen Village Phone, Bangladesh[43]

Criteria	Score
Affordability	5
Reliability	5
Usability	5
Sustainability	5

A similarly flexible yet comprehensive model of support and training is provided by the Grameen Phone initiative. Training is provided to all Village Phone (VP) operators as to how to set-up and use their equipment and limited additional training is then expected. Grameen Telecom, the non-profit organization which supports the project, tracks trends in phone use and identifies Village Phone operators who are having difficulty marketing or collecting payments. Support and help is provided during weekly face-to-face meetings to collect phone revenues. Grameen also provides a direct customer service facility, available 24 hours a day, 7 days a week.

Key lessons

The key constraint for the provision of training and support to ICT initiatives in developing countries tends to be a lack of existing technical knowledge and the infrastructure in place to develop training schemes or support operations. As a consequence some projects, as with the Simputer in India, rely on external and expensive support models. Although the support is available both online and by phone, at a cost of between US$125 and US$749 per month[44] it is prohibitive for the majority of low income users.

The provision of training and support are key to the sustainability of ICT projects and yet they are seldom elements which are focused upon when projects are being designed and initiated. The most successful methods of training and support therefore appear to be those that offer a number of options as well as self-sustaining options such as train-the-trainer with a view that capacity is better developed if individuals have the initiative to pass on what they learn. A number of initiatives have retained a model of external support and provision of training which, although it ensures quality service in the short term or may work to support the CSR aims of international organizations for example, does little to develop local-level IT capacity. The long-term sustainability of IT initiatives might therefore be better focused on developing local skills with a view that local provision of training and support are key elements of any initiatives sustainability.

Cost Structure and Financing

Introduction

The final defining component of any ICT initiative is the means by and structure within which an initiative is set-up and its ongoing financial and business strategy, A sound business plan and organization are key elements whether the initiative is to be run as a non-profit short-term scheme or is designed to be self-sustaining or profit making.

The cost structure and financing of ICT initiatives is therefore a key element in ensuring the creation and sustainability of any ICT initiative. The majority of projects investigated for the ITAFE matrix adopt a mixed model of financing and

42 World Resources Institute July 2001 http://www.digitaldividend.org/pdf/educar.pdf

43 World Resources Institute 2001 http://www.digitaldividend.org/pdf/grameen.pdf
http://www.grameen-info.org/grameen/gtelecom/

44 http://www.simputer.org

ITAFE Matrix

most are designed to move towards self-sustainability after a pilot stage. The funding program and business model chosen not only determine the strategic roll out of a project but also heavily impact upon elements such as local buy-in and ownership and relations with the government. Careful consideration of the type of cost structure and financing adopted is required given that the decisions taken have an immediate and long-term impact upon the initiative's success, its scalability and its sustainability.

Types of cost structure and financing

The options for the cost structure and financing of initiatives split primarily into funding from donors, public sources, private investment and a combination of public/private investment. Within each option, initiatives are able to operate on a for-profit or non-profit basis. In the case of for-profit initiatives, different approaches are also adopted as to the split of profits and liabilities, often with the aim of ensuring buy-in and ownership at the local level.

Donor grants

The provision of funding from donor grants is frequently used to ensure up-front funding for initiatives from a mixture of public and private investors. Grants received are not necessarily tied in to the need to generate profits and for that reason can be extremely beneficial to initiatives during their pilot phases whilst they are operating on a non-profit basis. In many cases, ICT initiatives receive grants in the form of equipment which allows the initiative to be set-up and upon which the donor expects no return. Grants are also used beyond pilot phases in order to subsidize the rollout of initiatives or where the structure of the initiative is such that local level operations operate sustainably but the non-profit founding company is reliant on grants in order to continue to operate.

Public investment

Although seldom the single source of funding, a key source of investment comes from international, federal, state and local governments. Such investment usually takes place in conjunction with private sector investment and with a view that the projects funded will become sustainable and will generate social or economic development in return for public investment. Particularly in the developing world where government stability and transparency is often questionable, using public investment can be an insecure method of ongoing operations. In addition, public investment is constantly under review and may not therefore constitute a secure and sustainable method of financing initiatives.

Public/private investment

Feasibly a more sustainable and transparent method of harnessing available public funding is to tie it in with private investment. Most developed world governments have a budget for investment in development initiatives, often funneled through organizations such as USAID, DFID or the IDRC, as do federal, state and local governments. Gaining government support for initiatives and building partnerships between private investors enables ICT initiatives to position public funders as key stakeholders, which is likely to encourage buy-in at a national and local level and cooperation. In some cases, governments even act as the major partner in initiatives, with the specific purpose of promoting economic opportunity, education and health. On the whole, the cross-over between the role of government and the social development aims of ICT initiatives means that they are a key stakeholder and beneficiary of such projects and that all efforts possible should be made to tie them in and ensure mutual benefits.

Private investment

Many initiatives, however, choose to build strong relationships with governments without relying on funding for buy-in. In most cases, such initiatives tend to be financed by national or international corporations building for-profit initiatives, often with established relationships with governments. In such cases, corporations have pre-existing funding for initiatives which they choose to invest for a mixture of philanthropic, revenue generating and market-seeding reasons. Strong relationships with banking partners must be developed or exploited to ensure financing for local operatives, with marketing partners to ensure promotion of the initiative and with external partners to ensure ongoing funding whilst the project achieves profitability. Private investment in bottom of the pyramid initiatives has become a growing phenomenon in recent years as corporations recognize the revenue generating possibilities of this customer segment, as well as the social and economic development which can be generated through responsible investment.

ITAFE Matrix

Criteria for assessing cost structure and financing

Assessing the pros and cons of the different types of cost structure and financing of ICT initiatives requires an understanding of how well the business model for each initiative has been designed, the source and structure of start-up and ongoing financing and the reliability, transparency and sustainability of the funding options chosen.

Viability
The viability of ICT initiatives can be assessed according the proven business case for a market for their services and the sound design of a roll-out plan for a sustainable initiative. Irrespective of the scale of the project, all initiatives require evidence that a market exists for their services and the development of a roll-out plan which outlines the proposed financing, pricing, marketing, technology and customer loyalty plan which will ensure that the initiative operates either sustainably or is profit-making. Initiatives which fail to understand the market they are entering and the requirement for services will, irrespective of the funding available and the cost structure put in place, fail to succeed.

Start-up funding and cost structure
The establishment of founding investment is key for any initiative but particularly for ICT initiatives where start-up costs for equipment can be high. Included in the start-up costs must be consideration of investment required to overcome constraints in areas such as power supply and connectivity, without which projects will not be able to function. Many initiatives rely on donated equipment at their inception as a means to keeping down start-up costs and therefore moving as quickly as possible towards a sustainable business model. This tends to be less of an issue where the initiative is supported by a private investor or corporation who can afford the up-front capital required to invest in infrastructure. Such cases often enable more ambitious business plans including infrastructural options such as satellite connectivity which, whilst expensive, are invaluable for reaching remote areas and maximizing social and economic development.

Ongoing financing and cost structure
Start-up costs and financing are essential for getting an ICT initiative off the ground and running. However, it is the ongoing financing and business model of an initiative which enables it to transition from a cash-absorbing to self-sustaining model with the ability to deliver long term benefits. The majority of successful ICT initiatives establish from the outset a clear timetable over which returns on investment and profitability are expected. Whilst ongoing donations can serve to support the non-profit founding organization or to enable the ongoing roll-out of the initiative, sustainable projects need to indicate that they can move towards break even or profitability soon after the pilot stage of the project is completed.

There are a number of options for ensuring that this is the case. The first is stakeholder buy-in which ensures that partners in the initiative have a key interest in its successful transition to profitability. Even with small-scale initiatives, designing the financing model so that it becomes self-sustaining as soon as possible is important for ensuring that all stakeholders are bought in to the success of the project. Another key element for ensuring self-sustainability or profitability is an upfront understanding of the running costs of a project and a business model which accounts for ongoing support costs and the revenues required to balance these out. As at start up, business models need to understand the required take-up of their services and account for marketing and promotional costs to ensure this in order to create a sustainable business model. Finally, a key element for a sustainable model is one which can ensure ongoing financing as required. The sustainability of financing options and renegotiation of funding opportunities will be critical to the ongoing success and scalability of any ICT initiative.

Transparency
Linked in to the idea of sustainability of funding is a requirement that the sources of funding are reliable and that the likelihood of the misappropriation of funding is limited as far as possible. Transparent operations ensure that the likelihood of misappropriation remains low and consideration of conflicts of interest and ethical conflicts in funding are also important for reducing financial concerns around possible business models.

ITAFE Matrix

Devising solutions

The sustainability of cost-structure and financing is, therefore, a key part of any ICT initiative. A number of successful examples in the ITAFE matrix have operated in their pilot stage as non-profitable enterprises however most have moved towards sustainable operations as a means to ensure that they have ongoing developmental impact.

Voxiva Alert, Peru[45]

Criteria	Score
Financial success	5
Scalability	5
Sustainability	4

The Voxiva Alert initiative in Peru, funded initially by philanthropic investments from major corporations and the Peruvian government, was mandated by the company's CEO to reach breakeven 2 years after its set up in March 2001. Having set up profitable and self-sustaining businesses in each country they operate in, Voxiva's founding company, based in the US is able to focus on securing significant ongoing funding from angel investors and top-tier investment firms in order to continue to expand globally.

Some constraints in the operating model continue to exist however. As Lima remains the cost-centre of operations it carries a significant proportion of Voxiva's cost-burden which restricts its ability to operate profitably. The ongoing sustainability of Voxiva's operations will also be dependent upon them overcoming challenges such as the long sales-cycle associated with working with the government and the complexities of balancing social benefits and business opportunities whilst operating across five continents.

E-Choupal, India[46]

Criteria	Score
Financial success	5
Scalability	4
Sustainability	4

Another example of all round success in terms of funding, cost structure and business model are the e-Choupal information kiosks. Backing from ITC, one of India's major private companies, played a key role in the initiative's set-up, paying the upfront funding costs to cover the $3,000-6,000 set-up cost of each e-Choupal. However, the e-Choupals are designed to generate operating profits for individuals at all three-tiers of the operating model. ICT predicts that it recovers its costs within the first year of the e-Choupal's operations. The model receives local support because it raises the incomes of local farmers and commission agents. Finally, in absolute terms saves both ICT and local farmers close to US$6 per metric ton in comparison to the previous method of operating.

n-Logue, India[47]

Criteria	Score
Financial success	4
Scalability	3
Sustainability	3

Another example of a three-tiered franchising model that generates revenues at the local level, for the LSP and for the founding company is n-Logue's village kiosk initiative in India. The role of n-Logue in setting up the project is key to establishing and maintaining relationships with wide range of service providers, supporters and, crucially, the government. In addition, n-Logue has partnered with the National Bank

45 Michigan Business School - December 2003 http://www.bus.umich.edu/BottomOfThePyramid/Voxiva.pdf InfoDev 2003http://www.sustainableicts.org/infodev/Voxiva.pdf, C.K.Prahalad (2004) The Fortune at the Bottom of the Pyramid, Wharton School of Publishing

46 World Resources institute - Digital Dividend, Michigan Business School, http://www.digitaldividend.org/pdf/echoupal_case.pdf August 2003, http://www.unitar.org/hiroshima/ief04/Case%20study/eChoupalYoon.pdf, C.K.Prahalad (2004) The Fortune at the Bottom of the Pyramid, Wharton School of Publishing

47 July 2001 World Resources Institute http://www.digitaldividend.org/pdf/nlogue.pdf, http://www.n-logue.com/
M.L. Best & C.M. Maclay. Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle. The Global Information Technology Report 2001-2002:Readiness for the Networked World. Oxford University Press. 2002.
R. Kumar, A. Jhunjhunwala. Taking Internet to Village: A Case Study of Project at Madurai Region. MIT. 2002.
C. Blattman, R. Jensen, R. Roman. Assessing the Need and Potential of Community Networking for Developing Countries: A Case Study from India. 2002.

ITAFE Matrix

of Agricultural and Rural Development and the Indian bank to provide its projects and entrepreneurs with operating capital. A regional network of franchised Local Service Partners work in tandem with the company to set-up the access nodes for the kiosks and local entrepreneurs are recruited to establish village-level franchises.

The initiatives operating approach concentrates on high cash flows by securing 50,000 customers per node and offers LSPs a number of different franchising options. The first is a full deposit model where the LSP makes a refundable deposit of $20,000 and splits revenues 50:50 with n-Logue without owning any of its assets. The second model is a staggered investment model where the LSP makes a refundable deposit of $4,500 in year one and obtains $9,000 worth of access centre equipment in its name and a bank guarantee to pay n-loge $13,500 in year 2. Revenues are split 60:40 between n-Logue and the LSP and operating costs are evenly divided. n-Logue expects the initiative to break even in 5 years, generating $62m profits by year 5 on gross revenues of $235m, with LSPs breaking even in 3.5 years and kiosk operators in year one. The company will need to meet these goals and its existing relationships with the government and supporting organizations if it is to secure the $15m in capital (debt and equity, no grants) which it needs to reach its expansion goals.

CDI, Brazil[48]

Criteria	Score
Financial success	4
Scalability	3
Sustainability	3

An organization which has taken a very different approach to its cost structure and financing, but has still realized success in development terms is the CDI initiative in Peru. CDI was set up with relatively little operating capital and now runs with operating expenses of only $300,000 a year to support an 863 autonomous Information Technology and Citizen's Rights schools which have trained over 630,000 children and young people across Brazil to date. The initiative has created self-sustained models at each school which are maintained through revenue generated from charging for after-school activities – a popular practice in the creation of ICT centers in schools where there is also a wider community need for ICT access. Whilst the original funding for the model came from volunteers and NGOS, CDI has secured ongoing funding from major corporations and continues to rely on international organizations for the donation of equipment. None of the elements are designed to be profitable in the short-term but an important emphasis has been put on operations in each school functioning in a self-sustained, self-managed, self-advertised manner.

Computador Popular, Brazil[49]

Criteria	Score
Financial success	0
Scalability	0
Sustainability	0

In contrast to the success of CDI, the Computador Popular project in Brazil exemplifies project failure, despite sufficient set-up funding and an apparently sound business plan for the production and retail of PCs. The business model was designed to include a low-cost product, loan provision to ensure affordability and tax incentives from the government for businesses willing to manufacture the computer. Yet, despite an up front investment of $75,000 from the government the project failed to move beyond the research stage. Failure is attributed to insufficient private funding, a crash in the Brazilian economy but predominantly insufficient understanding of the cheap PC market, its progression over time and the likelihood for ongoing support from manufacturers.

48 Info dev Annual report 2003 http://www.infodev.org/library/AR/2003/annual03pt1.pdf

49 http://www.icamericas.net/modules/DownloadsPlus/uploads/Awards_Application/Computadores-Documento_Integrado.pdf, http://www.computadoresparaeducar.gov.co/quienes_somos.html

ITAFE Matrix

Key lessons

The key message which emerges from the ITAFE matrix is that a strong and sustainable funding program and business model are important to make an initiative both financially viable and sustainable. Equally, successful and sustainable models are those which are profitable at all levels of operating, ensuring buy-in from investors, middle-men and local operators. For many projects local or national governments are key stakeholders, either for the provision of finance, for tax relief or for legislative support for ICT initiatives. Given the complexities of states in the developing world, this factor can often be a complication and require considerable thought and planning to be overcome.

A number of the successful examples studied have operated in their pilot stages as non-profit enterprises and some continue to operate based on ongoing philanthropic funding from major corporations which requires annual requests for funding, the development of close corporate relationships and inevitably impacts upon a project's ability to operate independently. For this reason, most non-profit initiatives move towards the aim of self-sustainability after a short pilot period. The benefits for the initiative itself include the ability to be self-governed and managed, the flexibility to diversify and expand operations, freedom to grow and, most importantly, the buy-in of individuals at all levels of operations into the ongoing profitability of the initiative.

Case Studies

The preceding section has explained the ITAFE matrix and each of its "must-have" elements in terms of the criteria which must be considered when starting up or running an initiative and key lessons which have been learnt from the research and creation of the matrix.

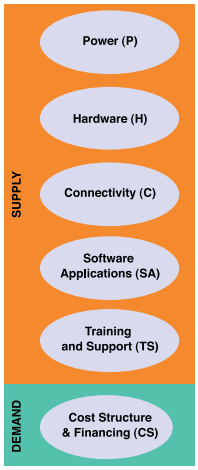
This section will now to discuss in greater detail four case studies of ICT initiatives which capture as a whole the real challenges and opportunities of ICT in the developing world. The four ICT4D initiatives are therefore evaluated below based on how each of the individual components of the ITAFE greenhouse – power, connectivity, hardware, software and applications, training and support, and cost structure and financing – interact with one another to create scalable, sustainable outcomes.

n-Logue[50]

Mission: n-Logue's mission is to provide access to services such as computer training, e-government, health care, etc. to those that do not currently have access, namely the rural poor, at a price point they can afford.

Brief History of Initiative: n-Logue was started in 2000 and incubated by the Telecommunications and Computer Network (TeNet) Group of the Indian Institute of Technology in Madras. Tamil Nadu, a state in Southern India, is the beachhead for n-Logue's operations. N-Logue provides services to the rural poor through kiosks run by local entrepreneurs and by providing training and equipment/connectivity. Kiosks include, at a minimum, an Internet-enabled computer with some local language software, a printer and power back-up. There are over 1000 kiosk operators now up and running. 47% of those kiosks are run by women.

ITAFE Matrix:



Connectivity: TeNet designed wireless local loop technology (WLL) as the basis for village level communications. The TeNet solution provides voice, voice band fax/data transfer and Internet connectivity at 25-70 kbps to 384 kbps. The average with this solution is 35 kbps (allowing for video-conferencing, but not for streaming). The subscriber wall set (WS-IP) can transmit both voice and data signals simultaneously to an access center which must be located within 10-12km (line sight of distance; hilly terrain will interfere). Coverage can be extended to 25km using a repeater. The infrastructure costs are kept very low as fixed WLL does not require extensive digging.

In taking into consideration the cost structure and financing part of the matrix in evaluating the connectivity choice of n-Logue, this solution is particularly elegant due to its ability to reach profitability with a small subscriber base. Most traditional land line or cell systems require a very large subscriber base to obtain profitability hindering their ability/desire to work in rural communities. This solution, however, has a central base unit/direct interface unit that handles traffic from 200-1000 subscribers. Hence, it works ideally in small, dispersed markets.

Hardware: Kiosks vary in the hardware each has on location. However, a typical kiosk would have the following components:

- CorDECT wireless system
- Telephone
- A 600 Mhz Celeron PC with 14" monitor
- Speakers, microphone, sound card and CD-Rom
- 16-hour back-up for telephone and 4 hour back-up for computer
- An STD PCO meter (if the kiosk is a public one)
- Dot matrix printer
- Local language software (word processing, spreadsheet, email, etc.)

50 July 2001 World Resources Institute http://www.digitaldividend.org/pdf/nlogue.pdf, http://www.n-logue.com/
M.L. Best & C.M. Maclay. Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle. The Global Information Technology Report 2001-2002:Readiness for the Networked World. Oxford University Press. 2002.
R. Kumar, A. Jhunjhunwala. Taking Internet to Village: A Case Study of Project at Madurai Region. MIT. 2002.
C. Blattman, R. Jensen, R. Roman. Assessing the Need and Potential of Community Networking for Developing Countries: A Case Study from India. 2002.

Case Studies

Typically, kiosk operators purchase all of the above equipment for less than $1000. Approximately $135 to $250 of the $1000 is purchased with their own capital. The remainder is financed through small loans administered by "partner" banks arranged by n-Logue.

Power: In evaluating power options for n-Logue, consideration needs to be given to both the solution for base stations and for the kiosks as each have varying power needs and are essential to the end-to-end solution.

The power choice for the base station has two interesting design features. First, the stations use a solar panel for energy. Many of the base station locations are off of the electricity grid, a not uncommon phenomenon in India where only approximately 56% of homes are electrified (according to a census conducted in 2001). Second, base stations are designed to not require air-conditioning, a power-hungry feature in many connectivity solutions, minimizing the power requirements of the base station and allowing it to run fully on solar power.

The kiosk power solution additionally takes into account the reality of intermittent power at best for places on the "grid" and no electric power in most of the rest of the country. Each entrepreneur is given a 16-hour power back-up for telephone and a four hour back-up solution for the computer. For those off the grid, there is the optional inclusion of a petrol start kerosene-run 400VA generator. The generator, however, is expensive at approximately US$210 dollars and is approximately $.10 per hour more to use than electricity. Those increased rates certainly cut into the margins of the entrepreneurs.

Software and Applications: To bring content and software to the rural market,[57] n-Logue has developed strategic alliances with content providers. There has been an explicit focus on developing the software applications in the local language. The types of services offered varies greatly from educational software such as computer training to e-government applications allowing citizens to submit petitions to government, obtain birth and death certificates to general communication applications enabling villagers to exchange emails and voicemails. As the kiosks take hold, the applications are becoming increasingly market driven and customized to the local market.

Training and Support: n-Logue has taken on the business of recruiting the kiosk operators themselves as they see the entrepreneurs' role as absolutely fundamental to the kiosks' success. They recruit from the large pool of graduates from India's many technical institutes. Once the operators are recruited n-Logue then, in turn, offers training and business advisory services. They do business advisory work with not only the operators at the kiosk level but also with the Local Service Providers (LSPs) which are discussed more in the next section on cost structure and financing. The LSPs also provide additional support to the kiosk operators.

Cost Structure and Financing: n-Logue's business model is particularly innovative, especially given all of the moving parts and partners needed to make their mission – to provide access to services such as computer training, e-government, health care, etc. to those that do not currently have access, namely the rural poor, at a price point they can afford – succeed. Here are some of the core components of their cost structure and financing model:

- To facilitate entrepreneurs access to capital, it has partnered with financial institutions such as National Bank of Agriculture and Rural Development (NABARD) and India Bank who have "fast-tracked" n-Logue loans
- Also creating incentives for entrepreneurs to open kiosks, the government has provided entrepreneurs a 15% subsidy on the principal loan amount
- To lower cost of hardware, it has partnered with ITT-incubated R&D and manufacturing companies and by obtaining volume discounts from suppliers
- To lower implementation costs, it has partnered with LSPs who maintain access centers, recruit kiosk operators, collect revenues
- To ensure incentives are aligned and profitability maximized, kiosk operators are also owners responsible for developing and marketing their own business offerings

51 In 2002, India's rural population constituted 72% of the total population of over a billion people. (Source: World Bank factsheet, 2003)

Case Studies

Kiosk operators make approximately $100 to $175 per month with around 85% of entrepreneurs making at least $65 a month within the third month of operation. Typically, entrepreneurs hit the breakeven point within one year. And, perhaps most impressively, as of April 2004 according to the company there has been 100% repayment of loans.

The Local Service Providers typically meet their breakeven within 3.5 years. An LSP typically covers one "project area" which includes 30-200 villages. Typically, year one will see an LSP bring on-line 100 installations and year two an additional 100.

n-Logue is a business as well and they anticipate breakeven within a 5 year timeframe.

Lessons Learned:

Several key lessons can be learned from n-Logue's approach.

1. **Build strong and robust consortium that incorporates each of the "must-have" elements.** n-Logue very early on in their project planning understood that "going it alone" was not an option. While n-Logue had a very innovative technology allowing for connectivity to parts of India previously unreachable, they needed strong partners in many other areas, partners that could provide financing for the entrepreneurs (banks, government), supply local connectivity (LSPs), engineer innovative power solutions (solar and generator companies), design software for local use in education, e-government, health, etc.(software companies) and provide the necessary local training to very "green" entrepreneurs. n-Logue therefore went about pulling each of these different members into its consortium to be able to provide value to the end-user. In ITAFE parlance, they carefully considered which partners could best contribute to each of the "must-haves" – connectivity, hardware, power, software and applications, training and support and cost structure and financing – and ensured that these entities were present early on in the planning process fully understanding the "greenhouse" dynamic at play.

2. **Create robust business model for each partner.** n-Logue also created a sustainable business model, not just for themselves, but *for each member of the consortium.* The incentives of all business partners are aligned. The LSPs, content providers, banks, entrepreneurs, n-Logue themselves all have a business proposition that encourages them to help expand the mission of n-Logue. This is not a philanthropic venture for any one of the partners. n-Logue has developed compelling business logic for not only attracting initial partners, but for those very same partners to scale and grow the number of kiosks in rural areas.

3. **Focus on niche market.** n-Logue did an excellent job of taking into account competitive dynamics and industry interests. They carved out a niche market – rural villages – that others had left behind enabling a wider breadth of consortia members to participate than would have been possible if potential partners had felt their "bread and butter" businesses were at risk of being cannibalized.

4. **Capitalize on entrepreneurialism.** No part of the n-Logue model is about "hand-outs" which contributes to its scalability and success. Even the government subsidy is aimed at simply lowering the hurdle for young men and women to become n-Logue entrepreneurs. But the owner/entrepreneurs still need to put their own capital into the kiosk. As such, they feel (and act) much more vested in the outcome. A small number of kiosks are not run by self-employed individual entrepreneurs, but by an NGO called the Dhan Foundation. The Dhan Foundation pays the operators a salary and covers all up front costs. *These kiosks have been dramatically less successful than those run by the operators who are responsible for paying back initial financing and who are eligible to receive a profit on the rest.*

5. **Focus relentlessly on end-user needs.** n-Logue has done an adequate job at this, particularly considering their current position and size. However, it is also one of the areas that research has indicated could be improved. Currently, most kiosk users are under 20 years old, most users are male and most users belong to the mid- to upper-income categories. n-Logue has a better

Case Studies

chance of reaching more of their target population with greater focus on the identification of end-user needs and the provision of applications that meet those needs.

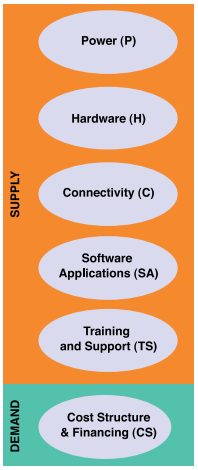
6. **Attack cost structure and financing from multiple angles.** Many ICT4D initiatives have lost momentum or died completely due to reliance on a single cost structure or financing model. In contrast, n-Logue had a multi-pronged approach to thinking creatively about cost structure and financing and did not rely exclusively on any one funding source, particularly government.

E-Choupal[52]

Mission: E-Choupal's mission is to re-engineer the procurement process for crops in rural areas of India by providing bottom of the pyramid farmers with access to market information and improved services which allow them to cut out the middleman, increase their profit margins and take greater control over their production and sales.

Brief History of Initiative: E-Choupal was conceived in May 1999 and launched in June 2000 by the International Business Division of ITC, one of India's leading private companies. The E-Choupal are set up in villages under the guidance of a Sanchalak (lead farmer) and provided with PCs and the infrastructure to allow connectivity to the internet in order to access information on prices, the weather, best practice etc. The aim is to offer farmers all the information, products and services needed to enhance farm productivity, improve farm gate realization and cut transaction costs. By mid-2003, more than one million farmers in 11,000 villages had been reached by 1,900 kiosks across four states of India, Madhya Pradesh, Karnataka, Andra Pradesh and Uttar Pradesh.

ITAFE Matrix:



Connectivity: The existing telecom infrastructure in place in the villages where e-Choupals are located was not capable of supporting the data traffic needed by the initiative. A solution was therefore developed with the Centre for the Development of Telematics, which improved output to 40Kbps but still faced problems with sporadic power supply. ITC have therefore decided to move to satellite-based technology (VSAT) which enables a throughput of 256 Kbps, despite installation costs of US$2,560.

This decision indicates the importance of making strategic decisions which balance costs against the benefits gained from using more advanced technology to ensure connectivity. Satellite technology overcomes many of the infrastructural constraints of traditional wire and landline options and ensures reliable, flexible and high-speed connections to even the most remote areas. In the E-Choupal case, the solution was only feasible because of ITC's support and their commitment to investing in and maintaining their own IT network in rural areas.

Hardware: A typical e-Choupal kiosk, located in a farmer's house, consists of a PC with an Intel Celeron processor and printer and is linked to the internet via phone lines, or increasingly VSAT connection. Each PC will serve an average of 600 farmers in 10 surrounding villages within about a 5km radius.

Each e-Choupal costs ITC between US$3,000 and US$6,000 to set-up, of which on average $3,700 represents the cost of equipment. Whilst the capital outlay for the company is high, the benefits gained, for example a reported saving of US$6 per metric ton of soy produce for both the farmer and ITC, mean that the venture for the company as a whole is profitable.

52 World Resources institute - Digital Dividend, Michigan Business School http://www.digitaldividend.org/pdf/echoupal_case.pdf August 2003
http://www.unitar.org/hiroshima/ief04/Case%20study/eChoupalYoon.pdf
C.K.Prahalad (2004) The Fortune at the Bottom of the Pyramid, Wharton School of Publishing

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Power: A reliable power supply remains one of the key constraints for the e-Choupal initiative, given the weak infrastructure in place in rural areas of India. The initiative was designed to run off mains electricity however, given known problems with the reliability of this source, a battery-based UPS (uninterrupted power supply including isolation transformer and spike suppressor) was built in to each e-Choupal. The solution means that the PCs remain effective between 90 and 300v. However, the back-up supply is still reliant on line power to charge it. In order to overcome this problem and improve both the flexibility and reliability of the power supply, ITC has therefore decided to move towards installing solar battery chargers at each location.

The power choice for the e-Choupal therefore takes into account two key elements. The first is the necessity of building a back-up power solution into the initial design of ICT projects, especially those located in areas which are poorly serviced by the electricity grid. The second is to base that back-up on renewable sources which require little existing infrastructure. However, providing such a flexible solution can be costly and ITC's buy-in to the initiative and willingness both to put in place the infrastructure required for a reliable power supply and to provide continuous investment to reach a solution has therefore been vital.

Software and Applications: The role of software in the e-Choupal initiative has predominantly been to support farmer's access to the internet. In areas where IT literacy may be low and knowledge of international languages poor, the e-Choupal PCs currently run on a Windows '98 operating system and, crucially, carry an Indian language word processing program (Ankur). In addition, each PC is provided with a short educational video on the e-Choupal and informational video clips on best-practice techniques such as soil testing. The opportunities for expanding on the software available through the e-Choupals are limited by their multi-user nature and time constraints on farmers to develop IT capacity. However, in addition to the promotion of educational efforts for farmers, kiosks are also being used by the community for educational, entertainment and wider business support services which is a further incentive to provide a simple software solution with multiple language options.

Training and Support: ITC has recognized the key role that training and support plays in creating a sustainable initiative and put in place a sound training program which develops local capability as well as providing flexible and affordable IT support. Sanchalaks receive day-long training before they are provided with equipment at the nearest ITC plant covering the fundamentals of IT and basic equipment and software support training. In addition, they are trained in quality inspection and pricing to support the processes which underlie the e-Choupal initiative.

At the time of installation a coordinator usually accompanies the vendor who installs the system. Sanchalaks are given one week to experiment with the computer and then invited to return to the hub or plant for a second phase of training which is individually tailored according to their comfort with the computer. A third and final phase of training takes place after a month and covers troubleshooting and basic maintenance. For most Sanchalaks the majority of the training, however, will be on the job and for this reasons only farmers with a natural drive are selected to undertake this role.

ITC has a pool of around 15 engineers who provide field infrastructure support, averaging between 1-2 callers per day at a cost of approximately US$6.60 per visit. In addition, each e-Choupal is visited about twice a month for infrastructure support. Support staff use one of 25 motorcycles purchased by ITC to overcome the problem of weak infrastructure in rural areas. ITC incorporates Samyojaks (local agents) into the system as providers of local support and also maintains the e-Choupal website and data uplink through its subsidiary, ITC Infotech India Limited.

Cost Structure and Financing: The e-Choupal business model is aimed at breaking down the existing mandi market structure which takes power away from small producers, cuts their operating margins and restricts the overall efficiency of the procurement process. Core components of their cost structure and financing model are as follows:

- ITC, as a major Indian corporation, has undertaken to develop the e-Choupals as a profitable enterprise which will be fully funded and supported by the company

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- As such, all upfront equipment and infrastructural costs are met by the company. The cost of each e-Choupal averages at about US$3,760 for equipment and US$2,200 on staff, travel, communications, software and training.
- Ongoing maintenance of about US$100/year/e-Choupal is also supported by ITC's existing infrastructure and the company continues to pay for farmer's transport costs to the procurement hub in order to drive down costs

Farmers selling to ITC through an e-Choupal typically receive a 2.5% higher price for their crops than through the mandi system as well as benefiting from lower prices to inputs and other goods and higher yields.

Samyojaks earn an income in the form of a 0.5% commission from ITC for providing logistical services that substitute for a lack of rural infrastructure, including information and market signals.

In absolute terms, both farmers and the ITC save about US$6 per metric ton of product. ITC reports that it recovers its equipment costs from an e-Choupal in the first year of operation and that the venture as a whole is profitable. The company has identified 3 sources of value which will help to scale the model in future:

- Crop-specific intervention
- Low-cost last-mile transport
- Intelligent first-mile for product and service development by farmers

Lessons Learned:

Several key lessons can be learned from the e-Choupal initiative.

1. **Recognize the potential of bottom of the pyramid producers and consumers.** As a major Indian agricultural corporation, ITC identified issues with the existing method of procurement and strove to design a solution that would empower bottom of the pyramid producers and provide them with the information to improve their processes and profit margins. A good understanding of the problems with the mandi system and faith that local farmers, if provided with the right infrastructure, could work within a new process, meant that ITC were able to create an ICT initiative which treats bottom of the pyramid farmers as legitimate partners and benefits consumers and the wider community.

2. **Devise a business model which benefits all partners involved.** Based on the understanding described above and the drive to set-up the e-Choupals, ITC were able to create a system which has proved profitable for the corporation, the Samyojaks, Sanchalaks and local farmers. This structure promotes sustainability by ensuring that there are benefits for all involved in making each of the e-Choupal kiosks operate efficiently, transparently and profitably.

3. **Focus on tackling a specific issue at the outset with a view to expanding scope once the program is up and running.** The e-Choupals were set up initially to deal solely with soy produce, effectively acting as a pilot program to ensure that the model worked and was scalable. Having achieved this successfully, ITC have since been able to develop plans for the expansion of the model to other crops, regions in India and countries.

4. **Create a model with local buy-in, based on existing initiative and capacity.** ITC had the infrastructure and capital required to create the e-Choupals independently but without local buy-in and ownership the initiative would not have got off the ground. With this in mind, local farmers and agents were chosen based on their existing capabilities and experience and the likelihood that they would therefore act as entrepreneurs to develop each e-Choupal.

5. **Tackle infrastructural constraints from multiple angles.** Overcoming the infrastructural constraints of rural India has been vital to making the e-Choupal initiative successful. ITC have the resources, the determination and the technical capabilities to consistently develop solutions which overcome these constraints.

6. **Build a strong training and support model with a view to creating a sustainable initiative.** Again, ITC as a major corporation has the capabilities and infrastructure required to put in place a

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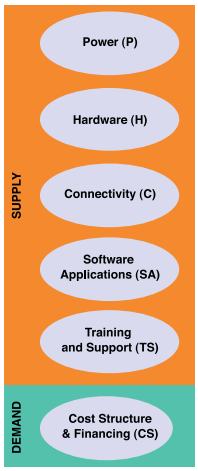
training and support program which can be designed around user's needs. They have been innovative in developing solutions to overcome infrastructural problems and have built programs which promote the self-sustainability of the e-Choupals.

Voxiva[53]

Mission: Voxiva's mission is to create an international for-profit organization designed to facilitate the reporting and communication of public health information with health professionals in areas without Internet access and to do so rapidly and with no investment in new hardware.

Brief History of Initiative: Voxiva was founded in March 2001 as a US company with funding from the Markle Foundation and other major corporate backers. Peru was chosen as the pilot site because the existing telecommunications infrastructure had sufficient reach into rural areas and because of a strong partnership with Peru's Ministry of Health. The pilot connected c204,000 individuals in 2 sparsely populated districts south of Lima to the national health surveillance system, incorporating 76 health clinics and centers. By 2002 the Alerta system had submitted 4,269 reports and 28,269 cases electronically. It has since been adopted for use by the Peruvian Navy and has been asked to expand its cover from 76 to 188 additional health facilities in 2 additional areas, one of which is predominantly rural and the second urban.

ITAFE Matrix:



Connectivity The Alerta service in Peru allows users either to dial a free phone number in order to connect to a secure server via the existing telephone network or to enter their information over the internet. Users receive an account number, PIN and plastic card with simple instructions and a code for all the diseases they need to access the system. Additional information can be attached in voice files. Use of the existing Peruvian telephone infrastructure network has been a key factor for the success of the Voxiva project, ensuring that additional infrastructure does not need to be built.[54] Only in a few areas without telephone networks is connectivity constrained. In these areas where Voxiva is being used in remote military operations, integration of radio waves as a form of reporting is required.

Hardware: Voxiva uses existing hardware in the form of phones, PCs and radios to allow users to connect to the Internet or access their voice accounts.

Power: Voxiva's power requirements are met by existing infrastructure used to power phones and the internet.

Software and Applications: Disease reports received by health authorities can be exported to various programs for analysis and presentation. GIS systems can also be used to view the data using dynamic maps. Users access the Voxiva reporting system directly via the Voxiva website. Health authorities can monitor incoming cases through a Web interface through which individual disease reports arrive in real time. The system is an open one which makes integration with the existing IT health system used by the Ministry of Health as simple as possible.

53 Michigan Business School - December 2003, http://www.bus.umich.edu/BottomOfThePyramid/Voxiva.pdf, InfoDev 2003http://www.sustainableicts.org/infodev/Voxiva.pdf
C.K.Prahalad (2004) The Fortune at the Bottom of the Pyramid, Wharton School of Publishing

54 At 78 telephone mainlines per 1000 people, the Peruvian telephone infrastructure is relatively more developed than other developing countries. Bangladesh, in contrast, had 4 telephone mainlines per 1000 people in 2001 and India 38 per 1000. Source: World Bank factsheet "ICT at t glance" 2003

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Training and Support: By 2003, Voxiva had trained 149 health personnel to use the Alerta system in Peru. Training included administration of user and group accounts, how to submit reports and retrieve voice mail. Many of the end users who work at either health posts or in the Navy are not familiar with the use of IVR and voicemail, therefore ongoing training is required.

Cost Structure and Financing:
Voxiva Peru is currently owned by the founding company, Voxiva, in the US and operations in each country are designed to be profit-making. The initial investment for Voxiva came from socially minded corporations, $250,000 from Ben and Jerry's Ice Cream and $500,000 from the Markle Foundation. An additional $250,000 of funding for deployment in Peru cam from the World Bank's Infodev program. Voxiva has since raised more than US$8m from angel investors and top-tier investment firms like Allen & Company in New York. Lima currently operates as the cost centre of the company's operations and carries significant proportion of the cost burden which puts pressure on it becoming a profit centre.

The main elements of the Alerta project which made it simple to finance were; insignificant start-up costs due to piggybacking on existing telecoms infrastructure, a close working relationship with the Peruvian government and local health officials and corporate partnership with Telefonica, Peru's largest phone company.

For the Peruvian government, the Alerta system operates on a fee per user per month basis with a minimum 1,000 user model. An evaluation of the pilot in Peru by the San Marcos University found that Alerta required a substantially lower allocation of resources, lowered operating costs by 40% compared with a traditional paper system and resulted in a 3-fold increase in reporting coverage.

At a company level, Voxiva faces the challenge of continuing to deliver quality service across projects in five continents. It must balance business opportunities over social benefits and short-term results over long-term impact. Another main challenge for Voxiva is the long sales cycles involved in working with governments and international development agencies. The company's current strategy for overcoming the problem is to work with government-approved contractors who are better set-up to initiate and quickly implement technology projects.

Lessons Learned:

Several key lessons can be learned from the Voxiva initiative:

1. **Build a sound business model which meets a specific purpose but is replicable across many locations.** Voxiva's US-based founding company designed the Alerta scheme around a concept that met a specific need in Peru but which they believed was based on a more broadly applicable and scalable model. The pilot program proved that this model was workable in a suitable environment and has provided a springboard for expansion to other purposes and locations across the world.

2. **Establish sufficient set-up funding and core investment relations to ensure pilot project will be fully funded.** A key element of developing this business model was attracting sufficient funding from corporations and investment organizations to cover set-up costs. Voxiva has built strong relationships with these partners and managed these relationships well to ensure that funding for expansion is forthcoming. Corporate relationships also enhance the profile and visibility of a project.

3. **Build strong government relations when operating in a vertical which is heavily influenced by government policy.** Without government support in Peru, the Alerta project would not have been viable. Voxiva needed to build and prove a sound business case for the Peruvian government and then work closely with them to ensure that the pilot worked successfully and resulted in an ongoing relationship. Working with governments, particularly in developing world contexts, often incurs time lags not experienced in business and requires the development of a specific set of negotiation and relationship management skills.

4. **Use existing infrastructure where possible to provide connectivity, hardware and power for initiatives.** A key success factor for the Alerta project

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was the use of the existing telephone networks to allow users to create disease surveillance reports. The innovation was in the use of the networks themselves, allowing users to access the system individually via phone or the internet and allocating each user a voice mail account which can be accesses when the log on and which allows them to receive health alerts, information about diseases, vaccination programs and training opportunities. Automatic notification of reports is received via email, voice mail or SMS and users can communicates with each other peer to peer using voice mail, SMS or the web.

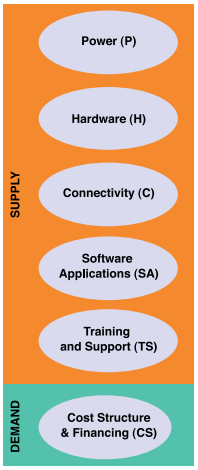
5. **Ensure that the company and its in-country operations have the correct cost structure in place to support a global enterprise on an ongoing basis.** One of the ongoing problems faced by Voxiva is the challenge of operating a rapidly expanding business across a number of different continents. Their ability to scale the model has been challenged by the variety of locations in which they have undertaken the work and cost structural constraints such as the location of the companies cost centre being in Peru at present.

Grameen Village Phones, Bangladesh[55]

Mission: Grameen Village Phone's mission is to promote rural entrepreneurialism in rural areas of Bangladesh through the creation of franchises which provide easy access to telephone services across the country, gradually bringing the full potential of ITC to the doorsteps of consumers who have never before had access to such services.

Brief History of Initiative: The Grameen Village Phone initiative was started in 1995 by Grameen Bank, an organization which has promoted economic development through the provision of microfinance loans in rural areas of Bangladesh for many years. Grameen Bank formed Grameen Telecom, a wholly non-profit organization, to provide the service to rural areas, in conjunction with Grameen Phone Ltd, a for-profit cellular-phone service provider in which the bank holds a 35% share. By 2001, the project had 5000 Village Phone operatives, providing telephone access to 12.5m people with an average of 70 customers a month using each phone.

ITAFE Matrix:



Connectivity: Faced with the control of the switched network by a government monopoly operator, BTTB, Grameen Phone made a strategic decision to enter into a long-term agreement with Bangladesh Railways to lease the railways underutilized high capacity fiber optic digital transmission network to serve as the backbone of the telephone system. Only in areas without fiber optic infrastructures, such as the southern coast, has the company built microwave links.

Given that connectivity is a key element of the VP project, the decision to create an innovative solution using existing infrastructure was vital for the project's set up. More recently, Grameen Phone Limited has seen the benefits of its strong relationship with the government and has been awarded a national license for GSM 900 cellular mobile phone services, making it the country's dominant mobile carrier. The initiative is now able to use GSM cellular technology as the network technology and, with 227 base stations and 634 cells, has coverage of nearly 30% of the population.

GP has also recently introduced external HG antenna which both ensures smooth call completion in areas of weak signal and extends coverage for VP operations. Other future solutions may include fixed wireless terminals, which would extend coverage with good quality signals but at a relatively high-cost, and mast head amplifiers used close to villages to increase the coverage of the network solution. Consideration of both solutions highlights how important connectivity is to the initiative and the company's

55 World Resources Institute 2001 http://www.digitaldividend.org/pdf/grameen.pdf
http://www.grameen-info.org/grameen/gtelecom/

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ongoing commitment to continue to develop innovative solutions that expand their reach and service. However, given the strengthening of GPs competitors in the market, all of whom use wireless local loop systems which cover more distance from the masts and provide better bandwidth for data transmission, the company will need to make headway in this area if they are to remain ahead of their competitors.

Hardware: The basic package provided by GT for a Village Phone operator includes a Nokia 5110 transceiver, battery, fast-charger, sign-board, user guide in Bangla and a price list for different destinations. As of March 2001, VP had 4,543 phones in service which typically remain grounded in public phone offices and do not move from place to place.

Power: Power for charging phone batteries remains a problem for the Village Phone project. There are villages in Bangladesh with network coverage but without electricity which makes mobile phones in that area unusable. Despite the existence of wind-up technology, for example a wind-up phone charger developed by the Freeplay Foundation, this and other renewable sources have not so far been harnessed by the initiative, possibly because costs are prohibitive.

Software and Applications: All the Nokia Phones provided by the initiative, come with standard applications. However, given the nature of the initiative, there is limited requirement for a complex phone package, although this may develop as the market matures.

Training and Support: Given the basic nature of the hardware and software which underlies the VP initiative, training has tended not to be a major element of the initiative. GT provides basic training to each Village Phone operator on how to use the phone and it is assumed that this knowledge will then be passed on by the operator to their customers.

More important for the sustainability of the initiative has been the provision of support, both technical and business. Support is provided by the GT unit office nearest to each operator, whose responsibilities include identifying new areas of signal coverage, selecting new VP operators and training and maintenance.

GT also tracks trends in phone usage and identifies operators who are having difficulty marketing or collecting payments for their services. Additional support and help is provided during weekly meetings to collect phone revenue and a direct customer service phone line is available to cover problems with phone usage 24 hours a day, 7 days a week.

Cost Structure and Financing: The cost structure and financing of the Village Phone initiative has been a key element of its success. For the non-profit GT organization, ownership by the Grameen Bank, and a 35% share in GrameenPhone Limited has meant 50% discounts on phone rates and access to micro-loans for all of its operators. More importantly, it means that all three companies have a combined interest in the success of the VP initiative and in building a sustainable and scalable business model.

The use of a franchising model has also been essential for ensuring buy-in at operator level. Village phone operators are selected by local Grameen Bank branches on the basis of a good repayment record, ownership of a good business and the spare time to run a VP, literacy and residence near to the village centre. GT buys a cellular phone subscription from GP for each entrepreneur and provides the necessary hardware and training. GB lends GT the price of a phone and connection fee, which is repaid in installments within a stipulated 2-3 year period with typical repayment rates of 90-95%. The typical price of a basic set-up package is Tk12,000 (US$220).

VP operators pay a minimum monthly bill of Tk154 which includes monthly line rental, VAT and service charge along with Tk100 towards an annual government license/royalty fee. Telephone rates are generally twice the wholesale rate charged by GP plus taxes and an air-time fee whilst incoming calls incur a flat charge. To compensate for administrative costs incurred by GT and GB, 15% service charge is added to the total GP bill. Individual operators of VPs make a profit of about Tk2,500-5,000/month (US$50-$100).

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Lessons Learned:

Several key lessons can be learned from Grameen Phone:

1. **Create a business model which operates with commercial principles.** Key to the success of the Grameen Phone initiative has been the company's unusual hybrid organizational structure. The support of the Grameen Bank and Grameen Telecom organizations, and GP's tie ins with both of these companies, not only provides benefits such as loan provision and cheap services but a pool of business experience and capital for the project. The size of the Bangladeshi population, 136 million in 2002;[56] and potential reach of a project into previously unexploited bottom of the pyramid markets provide a unique incentive for corporations and NGOs to wok together to promote similar attempts to develop economic opportunity.

2. **Use a franchising model to ensure local buy-in, sustainability and scalability.** The creation of VP franchises has ensured the promotion of local entrepreneurialism by allowing operators effectively to run their own businesses. This has had a particular impact on women, who make up the majority of the operators, and who do not traditionally have access to the capital and infrastructure required to set up businesses like the Village Phone.

3. **Build strong government relationships to ensure legislatory support.** Strong government relationships are key to projects which use cellular and switched networks because in many developing countries they remain state-controlled. Despite a challenging beginning to the project, the combined weight of the GP and GB organizations and their relationships with the government has enabled GT to benefit from the granting of a cellular network contract to Grameen Phone Ltd.

4. **Continually strive to overcome infrastructural issues with innovate solutions.** As the example above illustrates, GT operates in an environment where there are few guarantees about the availability or flexibility of infrastructure. The initiative has proved that it is able to devise innovative solutions to overcome connectivity problems but has had less success in tackling weak power infrastructure through the use of renewable sources. This is a major constraint on the project and indicates the importance of viewing the infrastructural "must-haves" of ICT projects holistically.

5. **Select entrepreneurs with a good business history and the potential to develop their businesses.** Pre-selection of candidates to become VP operators was made possible through links with the Grameen Bank and has ensured that entrepreneurs with drive, experience and good skills are running each of the phone operations. This reduces the requirement to invest in training and capability development and means that the model is more likely to be self-sustainable.

6. **Provide strong business and technical support to the business model.** Despite the existence of pre-selected candidates, GT has remained focus on developing each of its operators to the fullest of their capabilities by providing on-hand support and in some cases going as far as to insert competitors into markets where they do not feel the entrepreneurs are maximizing their profits. An ongoing support model promotes sustainability and provides incentives for operators to continually improve their businesses.

56 World Resources Institute 2001 http://www.digitaldividend.org/pdf/grameen.pdf
http://www.grameen-info.org/grameen/gtelecom/

Lessons Learned

The four case studies ITAFE analyzed, as well as the two dozen other projects researched from around the globe, have led to several key lessons guiding both ITAFE's efforts in Brazil and in its potential expansion to other countries:

1. **Focus relentlessly on end-user needs.** The projects that failed most abysmally did not have a focus on the end-user. In those situations typically a donor and/or NGO had conceptualized what they believed the end-user to need and designed a project to those specifications. But when the solution was rolled out, the needs of the end users differed from the perception of what their needs were. Rigorous, structured, grass roots research of end-users needs, to the contrary, has yielded much higher success rates in ICT4D initiatives. Hand-in-hand with the focus on end-user needs is the importance of recognizing the potential of the bottom of the pyramid producers and consumers.

2. **Build strong consortium that holistically incorporates each of the "must-have" elements.** Every single successful project analyzed went about creating their particular ICT4D solution through the creation of a consortium that systematically addressed each power, connectivity, hardware, software and applications, training and support, and cost structure and financing.

3. **Create robust business model for each partner.** Part and parcel of building a strong and robust consortium is the building of a sustainable business model, for each member of the consortium. The most successful projects from around the globe understood that their success was only as strong as the weakest member of the consortium. Hence, great care was taken to ensure that the incentives of all business partners were aligned.

4. **Focus on niche market.** The most successful projects took into account competitive dynamics and industry interests and carved out a specific market for themselves. That allowed a wider breadth of consortia members to participate than would have been possible if potential partners had felt their "bread and butter" businesses were at risk of being cannibalized.

5. **Capitalize on entrepreneurialism.** The initiatives that have attained the greatest scalability and replicability have harnessed the entrepreneurial spirit of those in the field. "Ownership" in the form of co-investment or sole investing, oftentimes through the use of micro-finance, has proven to be a key to success. The franchise model has been particularly effective in engaging otherwise "disenfranchised" members of society, such as women, in strategies that improve their livelihood. Local buy-in and designing initiatives with local capacity in mind is essential.

6. **Attack cost structure and financing from multiple angles.** Many ICT4D initiatives have lost momentum or died completely due to reliance on a single cost structure or financing model. Those with a multi-pronged approach to thinking creatively about cost structure and financing without a reliance exclusively on any one funding source (particularly government) have enjoyed the greatest success.

7. **Focus on tackling a specific issue at the outset with a view to expanding scope once the program is up and running.** Initiatives the quickest to lapse into failure were ones that were too ambitious at the outset versus those that started with concrete, modest objectives, worked out any kinks in processes and then expanded operations. However, equally important, is starting out with the expectation of the expansion of scope. Successful, scalable projects started small but designed processes at the outset to accommodate increased capacity in the projects' near future. Less successful ones created a model that worked on a pilot basis but did not prove scalable.

8. **Establish sufficient set-up funding and core investment relations to ensure pilot project will be fully funded.** A key element of developing effective business models was attracting sufficient funding from corporations and investment organizations to cover set-up costs. Successful enterprises built strong relationships with financial partners and managed these relationships well to ensure that funding for expansion is forthcoming. Corporate relationships also can enhance the profile and visibility of a project.

Lessons Learned

9. **Build strong government relations when operating in a vertical which is heavily influenced by government policy but do not rely solely on government support for a project's success.** ICT initiatives are prone to need certain levels of government support. Hence, gaining government buy-in early in a project's life-cycle is critical. Strong government relationships are key to projects which use cellular and switched networks because in many developing countries they remain state-controlled. It should be noted, however, that working with governments particularly in developing world contexts often incurs time lags not experienced in business and requires the development of a specific set of negotiation and relationship management skills. The most successful projects while gaining government support have built business models that are not reliant solely on on-going support from government.

Sources

Continent	Country	Project Name	Vertical	Sources
Africa	South Africa	**Vodacom**	Community	World Resources Institute - August 2003 http://www.digitaldividend.org/pdf/vodacom.pdf
Africa	Senegal	**S.A.R.L.**	Economic Opportunity	World Resources Institute - August 2003 http://www.digitaldividend.org/pdf/afrique_initiatives.pdf
Africa	Senegal	**Manobi**	Economic Opportunity	Digital Divide Network website http://www.digitaldividenetwork.org/content/news/index.cfm?key=760 Manobi website http://www.manobi.net/index.php?M=1&SM=1&lang=en Alcatel website http://www.alcatel.com/sustainable/fracture/fracture5.htm
Africa	Kenya	**Price Africa - DrumNet**	Economic Opportunity	Pride Africa Website http://www.prideafrica.com/partners.htm Wisconsin University website http://www.basis.wisc.edu/live/rfc/cs_02b.pdf"
Africa	South Africa	**UUNET Bandwidth Barn**	Economic Opportunity	South African information service http://www.southafrica.info/doing_business/investment/ oppurtunities/bandwidthbarn.htm
Africa	Regional	**African Virtual University**	Education	Information and Telecommunications Union website http://www.itu.int/osg/spu/wsis-themes/ict_stories/AVUcasestudy.html
Africa	Regional	**Freeplay Foundation**	Education/ Community	Freeplay foundation & Freeplay corporation websites http://www.freeplayenergy.com/ index.php?section=news&subsection=inthenews&page=18 http://www.freeplayfoundation.org/
Africa	Uganda	**Uconnect**	Education	Uconnect website http://www.uconnect.org/
Africa	South Africa	**The Compliance Service**	Health	http://www.bridges.org/iicd_casestudies/compliance/
Africa	Uganda	**HealthNet**	Health	World Resources Institute, - August 2003 http://www.digitaldividend.org/case/case_healthnet.htm Healthnet website http://www.healthnet.org/hnuganda.php Development gateway website http://www.developmentgateway.org/download/221026/Satellife.pdf Feb 2003, Bridges evaluation http://www.bridges.org/satellife/evaluation_pda_project_28_February_2003.pdf
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