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THE BENEFITS, INNOVATIONS, AND USES OF INFORMATION AND COMMUNICATION TECHNOLOGY AT THE BASE OF THE PYRAMID

IT for Underserved Communities

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Abstract

Information and communication technology is being used in the developing world by businesses, NGOs, and governments. They are supporting a variety of initiatives using various wired, wireless, and computer technologies. These initiatives provide advantages to local communities in the form of improved economic prospects, and consumer and social benefits. Companies and organizations may benefit as well by improving their operations, creating innovations, or finding new markets. We have analyzed over 1,000 initiatives describing such activities in India, China, Latin America/Caribbean, and Africa. We provide an empirical description of key features, innovations, and benefits of the initiatives in each region and the ways in which these regions are both similar and different.

Keywords: Bottom of the Pyramid, Base of the Pyramid, BOP, ICT, information and communication technology, development, innovation, benefits

Introduction

Over two-thirds of the people on the planet go to bed hungry, suffer or die from preventable diseases, or have drastically limited opportunities, due to their lack of education and training or the general economic conditions where they live. According to World Bank estimates, three billion of the world's population of six billion people live on no more than $2 a day, barely meeting their most fundamental needs. The figure grows to at least four billion by increasing incomes just a few dollars more. (http://www.netaid.org/global_poverty/global-poverty/) Sachs describes how nearly one billion people are too poor to even stay alive. (Sachs 2005).

The world has again put the goal of eliminating poverty at the forefront of an international agenda. The Millennium Development Goals (United Nations 2005) were drafted and signed by all members of the United Nations to set targets for serious reductions in poverty and related conditions by 2015. Eight top-level goals are:

· Eradicate extreme poverty and hunger
· Achieve universal primary education
· Promote gender equality and empower women

· Reduce child mortality
· Improve maternal health
· Combat HIV/AIDS, malaria and other diseases
· Ensure environmental sustainability
· Develop a Global Partnership for Development

Associated with each goal are more specific "targets," and with each target, indicators of progress. For instance, one target of the first goal is: "**Reduce by half the proportion of people living on less than a dollar a day."** The three indicators associated with that target are: 1) the proportion of the world population below $1 per day (PPP); 2) the poverty gap ratio; and 3) the share of the poorest quintile in national income or consumption. All these are calculated with reference to World Bank statistics.

There is considerable debate about how these goals should be met. Although many observers feel that foreign aid has proved futile or even counterproductive, others believe it has simply been misdirected. Jeffrey Sachs, Special Advisor to United Nations Secretary-General Kofi Annan on the Millennium Development Goals, directs the UN Millennium Project. In two villages, one in Kenya another in Ethiopia, the project is undertaking a series of inter-related actions, targeting, among other things, health (bednets, vaccinations, and antiretrovirals); agriculture (fertilizers and agro-forestry); power (generators); water (bore wells and filtration); and education (including school lunches with supplements). The project hopes to demonstrate that aid of approximately $100 annually per person, based on proper scientific and economic foundations, can eliminate poverty in these villages and is affordable according to the commitments that the leading world governments have already made.

Quite often, combinations of actors from different sectors can be more effective than a government, aid agency, company, or citizen sector group acting alone. Indeed, new hybrid forms of organizing the attack on poverty recognize this possibility. One of the more far-reaching is Lodge and Wilson's suggestion to create a permanent partnership among key MNCs, aid agencies, and NGOs to help define the "right" projects to address poverty and then to mobilize the "right" actors to carry them out (Lodge and Wilson 2006).

The range of technologies in use in the developing world may be surprising to those who are not familiar with what is occurring there. Cellular technologies are widespread, with India having the highest number of cell phones in use worldwide and much of Africa having the most rapid rates of diffusion in recent years. On top of these are other technologies specially designed for use in conditions where there is unreliable power and conditions are otherwise harsh. Nicolas Negroponte's organization, "One Laptop Per Child," is building a crank powered, "ruggedized" Linux-based laptop for $100 with flash memory instead of a hard disk plus wireless broadband that will allow users to form an ad hoc, peer-peer, mesh networks. The organization plans to donate these to schools in an effort to dramatically increase students' learning opportunities. Special ATMs using biometric readers help provide banking services for the illiterate (Hernandez and Mugica, 2003). Specially designed PDAs help healthcare workers gather information in the field and dispense packaged medical advice encoded in medical scripts (Prahalad 2005).

These examples indicate what is in the offing for ICT to support those living at the economic base of the pyramid, while hinting at its even greater potential. It is important to understand, as well, what is occurring more broadly and perhaps less dramatically. In other papers, we have begun to characterize base of the pyramid activity supported by information and communication technology, including: the relative prominence of different sectors (for-profit, NGO, government), funding sources (from aid to funding from revenues from services), technologies in use; and activities being supported (Gordon et al. 2005). We have also studied the types of innovations that ICT is bringing about plus the benefits it is providing both local communities and the organizations spearheading base of the pyramid efforts (Gordon et al. 2006).

In this paper, we want to focus on four regions where there is still dire poverty: India, Africa, Latin American/Caribbean, and China. We will describe the ICT efforts that are under way in those regions and then explore the types of innovations occurring and benefits flowing to citizens and sponsoring companies and NGOs alike. Our intention is to paint a picture of what is occurring in each region separately and to make some comparisons among them. We conclude this paper by suggesting some avenues for additional research that we hope the IS community will see fit to join us in as we seek to provide better opportunity to those living in poverty around the world.

Background

There is a substantial literature on the so-called digital divide. In this body of work, authors describe the disadvantages that accrue to those without or unable to use computers and connectivity. For example, Dewan and Riggins (Dewan and Riggins 2005) provide a comprehensive review of the digital divide's impact (from lack of availability of technology or difficulty in using it) on individuals, organizations, and globally. Related work, tracing back at least to Everett Rogers' early editions of his classic, *Diffusion of Innovations* (Rogers 1983), attempts to untangle the mysteries surrounding the adoption of various innovative technologies, and thus the impact they have on individuals or large groups including society as a whole.

While these efforts have a long history and an important place in research, we would like to stress that what we are attempting is something else: *Not* who is excluded from technology's reach; rather, who (among those typically excluded) *is* included? *Not* what disadvantages do lack of effective access to use of technology confer; rather, what is it being used for, and to what effect? *Not* when, if, and how technology will reach certain groups, rather where is it today?

As will be evident, our research is empirical. Rather than relying on case studies such as those described by Hart (Hart 2005) or Prahalad (Prahalad 2005), we believe that a statistical profile based on a relatively large sample is important to give foundation to studies that seek to understand the potential roles of ICT in addressing poverty and improving lives. While textured nuances are obscured by numbers, these numbers help give an important indication of what is occurring, where, as well as how well it is being accomplished

At the same time, our work is not strictly at the macroscopic level. Much important work has tied indicators of technology use to societal (economic) development. A series of volumes published as Global Information Technology Reports is quite comprehensive in this regard, where the unit of analysis is a country or region, and variables of interest include the numbers of PCs per hundred people, country income, and the like. In contrast, though our work is also numerical in the same sense, the unit of analysis is the "case." But rather than elaborately exploring its intricacies, we treat each case as a single data point with a vector of features including: its location, its technology, its innovations and its benefits. Thus, we have tried to strike a balance between examination of one or a few detailed cases, on the one hand, and macroscopic work on the other, where all the "cases" describing the occurrences in a particular region are collapsed to a few statistics**.** Based on our results, we hope other researchers can begin to find specific problems to dig into more deeply.

Methodology

The Digital Dividend database contains 1048 project capsules. Each project capsule is a summary of a base of the pyramid initiative involving information and communication technology (ICT). About 25% of the projects are initiatives where the principal organization responsible for the project is a multi-national company (MNC). Almost all projects provide some kind of benefit to local citizens as well as to MNCs or other sponsoring organizations. Paul (Paul et al. 2004) provides a descriptive analysis of case studies within this database.

Each project capsule is rich with information about the project, including a brief description, project initiation date, affiliated organizations, etc. Project capsules are categorized based on their *Sector* ("For-Profit", "Non-Profit" or "Government"), *and Location.* An *activity type* field captures the primary service that the project aims to provide to the local community. There are about 40 different *activity types* such as *Agriculture*, *Business Services*, *Computer Training*, *E-Commerce*, *E-Governance* etc. In addition, project capsules contain other information such as *Funding Sources and Project Needs.* A sample project capsule is provided in Figure 1.

The project capsules in the Digital Dividend database were identified through the combined efforts of Digital Dividend staff members, volunteers, practitioners in the field, and researchers. The intention of the collection is to be a complete catalog of all activities involving ICT at the base of the pyramid. Digital Dividend staff members conduct research and publish reports on the base of the pyramid. They also assist corporations and development agencies by providing information about development projects. The team also works on base of the pyramid projects and supports grassroots project initiatives. Digital Dividend maintains the collection through the efforts of two full time employees, who identify most cases. These individuals vet al.l projects submitted to check for accuracy and authenticity. They also prepare the capsule description (text and metadata), thereby ensuring the uniform construction of the cases and the integrity of the data they contain.

In our research, we were interested in analyzing the innovations ICT can bring about and the benefits it can provide (both to local citizens and sponsoring companies). Towards this end, we enhanced the existing data by providing each project with a primary innovation category and several benefit categories. From our experience and understanding, though these projects involved a principal innovation, many times they resulted in multiple benefits to the local community as well as MNCs.

AIDS Education of Local Media: UNESCO Africa

***Project Description**:* In an effort to help local media better understand and report AIDS-related stories, UNESCO has launched an education campaign through its African offices. Local coverage of the AIDS epidemic has often been sensational, leading to societal problems such as abandonment and stigma. Through a new Web site, African journalists can now access professionally updated HIV-AIDS research; such material replaces the sensational and outdated information that many writers based stories on in the past. Traditional communications technologies, such as press releases, and research libraries, will also be part of the campaign. The project's target countries include Kenya, Tanzania, Uganda, Burundi, Rwanda, Djibouti, Ethiopia, Eritrea, Somalia, Botswana, Malawi, Mozambique, Namibia, Zambia, and Zimbabwe.

Organization: United Nations Educational, Scientific, and Cultural Organization (UNESCO)

Contact Name**: **Contact E-mail: Contact Phone/Fax: Mailing Address:

Project URL:

Locations:

Africa/Zimbabwe/Harare/Harare, Africa/Zambia/Lusaka/Lusaka, Africa/Somalia/Mogadishu

Africa/Uganda/Central/Kampala, Africa/Tanzania/Dar es Salaam/Dar es Salaam

Project Users: ***Operating Since:*** Jun 20, 2003 ***Related Projects***: No related projects found.

Activity Type: Education Healthcare ***Sector:*** Non-Profit

Funding Sources: International Agency ***Affiliated Organizations: Project Needs:***

Figure 1. Project Capsule Example

We developed a classification scheme for innovations at the base of the pyramid, benefits to firms from their activities, and benefits to local citizens. (See Tables 1-3). According to Bowker and Starr (1999), a classification "is a spatial, temporal, or spatio-temporal segmentation of the world". They argue that a classification scheme is a set of "boxes" into which things can be sorted to create new knowledge. They also suggest that any classification exhibits the following properties

1. There are consistent, unique classificatory principles in operation.
2. The categories are mutually exclusive.
3. The system is complete.

We argue that there has not been a single unifying scheme for categorizing the innovations or benefits from ICT projects in development. We considered various approaches suggested in the ICT, innovation, stakeholder, development, and management literatures. Many initiatives strive to document quantitative performance. For instance, recent initiatives by ITU and OECD on measuring ICT for development have focused on quantitative indicators of ICT impact (UNCTAD 2005).

Qualitative efforts tended to be too general to be useful for our purposes. For example, Tidd et al. (2005) argue that there are four types of innovation: product, process, positioning, and paradigm. While our classification system also makes a rough cut between product and process innovations, we felt the need for a more refined set of descriptors for these ideas. We identified five types of product / service innovations, from creating new product categories entirely to slimming down the feature set of an existing product. Similarly, we viewed process innovations as being either internal to the firm (managerial) or involving aspects of its value chain. We established six descriptors

covering such innovations. In a similar way, Perkins et al.'s (2000) classification scheme was too general to serve our needs for identifying how ICT provides local benefits to communities. They characterize benefits along these lines: transfer of capital, job creation, technology transfer, managerial capability, and access to world markets. While we agree with these benefits, we have included all but one in a sub-category of "Local Community Benefits" we consider "(Local Community) Economic Benefits." But, we added two other sub-categories to "Local Community Benefits", that we feel are equally important and that Perkins' scheme does not capture at all: "(Local Community) *Social* Benefits" include improvements in citizens' access to healthcare, improvements in education, cultural preservation, and the empowerment of women (a key facilitating variable at the base of the pyramid). "(Local Community) *Consumer* benefits" include the non-economic benefits that consumers received in the form of more prompt or convenient service, expanded choice, higher quality products, etc.

Other classification schemes were too detailed for our purposes. For instance, Arun et al. (2004) break technological capability alone into seven major categories, including: non-production operational, non-production technical, adaptation without production, etc. That level of detail would not further benefit our study.

Thus, while many of the schemes we reviewed had elements similar to those that ultimately made it into our framework, none individually was what we were looking for. The schemes we employed for measuring innovations, and local and MNC benefits were developed in an iterative collaboration between two research centers emphasizing the base of the pyramid and ourselves. Each side contributed its theoretical and practical insights in helping to devise and refine the classification schemes we used in this research. Our classification system meets Bowker and Starr's (1999) desired criteria.

The classification scheme we used for innovations is listed in Table 1. (In Table 1-3 we show the top two levels of coding only). We mention deeper levels in helping to explain our results.) Innovations were categorized as *technological*, *organizational*, *value chain* and *product / service* innovations. An example describing innovation and benefits in detail is provided at the end of this section.

Table 1. Levels of Coding for Innovation

	Innovation Category	**Innovation Type**
Innovations	Technological	Re-purposed Western Technology
		Extended communication / improved information
	Value Chain	Supply Chain
		Manufacturing
		Distribution
		Novel Marketing
	Organizational	Managerial Leverage
		New types of social contracts
	Product / Service	Sizing / "sachets"
		Language / literacy
		New product features
		Slimmed down feature set
		New product category

The benefits gained by local citizens can be classified as either *social*, *economic* or *consumer* (Table 2). Any benefit that resulted in general social welfare including *improved healthcare* or *improved education* was classified as a social benefit. *Economic* benefits, on the other hand, involved some type of improvement of the economic conditions of the community. For example, projects that provided *job creation* and *reliable access to capital* were categorized as providing *economic* benefits to the local community. Finally, projects that provided *new products*, *better prices* or *improved facilitation of services* were identified as providing better *consumer* benefits.

Table 2. Levels of Coding for Local Benefits		
	Benefit Category	**Benefit Type**
Local community benefits	Consumer benefits	New product / service viable to provide
		Improved fulfillment
		Better prices
		Expanded choices
	Economic benefits	Job creation
		New types of jobs created
		Local business skills
		Reliable access to capital
		Access to new markets
	Social benefits	Cultural preservation
		Empowerment of women
		Improved healthcare
		Improved education

Benefits to MNCs were categorized as *economic* benefits or *improved firm capabilities* (Table 3). As in the case of benefits to local citizens, there could be multiple benefits to a corporation. For example, a new technology like SMS messaging could result in *increased profits,* which are *economic* benefits as well as *process improvement,* which is an *improved firm capability* benefit to the corporation. Please note, as well, that citizen sector organizations and governmental agencies (if they were the sponsoring agency for a project) might be coded as having received "MNC" benefits.

Table 3. Levels of Coding for MNC Benefits		
	Benefit Category	**Benefit Type**
MNC benefits	Economic benefits	Increased profits
		Increased market power – enhancing consumer's ability to buy
		Cheaper production
		Tap into future growth markets
		Constant product development
	Improved firm capabilities	Risk reduction
		Trial new technologies
		Design knowledge
		Export new business models to other developing regions
		Export new business models to developed regions

To illustrate the classification scheme outlined above, let us consider the well-known example of Hewlett Packard iCommunity[1] project. This project was piloted simultaneously in many locations including Houston (Texas, USA), Kuppam (Andhra Pradesh, India) and Limpopo (South Africa). The project description from the Digital Dividend capsule is provided in Figure 2 below,

An iCommunity is an ecosystem of public and private partners that will work together to create sustainable economic and social development opportunities in underserved areas through the use of information and communication technology (ICT) solutions. In each iCommunity, HP teams work with local partners to address issues such as technology access, education/ learning opportunities, employment/ job skills, community building/ increased civic involvement, and economic development. Set up as a sustainable business, iCommunities are built on the Digital Villages concept. The first iCommunity was launched in Mogalakwena, South Africa, and is to serve as a test-bed for new technologies to come out of the HP labs and to provide the feedback on which new products will be based. Other iCommunities are located in Kuppam, India, and Houston, Texas.
Figure 2. Sample Project Description

This project involves *product* / *service* innovation while providing *economic* and *social* benefits to the local community. At the same time, Hewlett Packard benefited from *improved firm capabilities* through new *design knowledge* gained from this experience as well as through the *trial of new technologies.*

To augment the original Digital Dividend data, three research assistants on our project team were involved in extending those data to code for innovations and benefits. To ensure reliable descriptions, two individuals read the original abstracts provided in the Digital Dividend cases as well as pertinent information obtained from cases' underlying Web sites and then coded each case independently. A third individual compared the two encodings and made a final determination about how to code the case if there were any discrepancies. Though cases might involve several organizations, coding was at the case (not organization) level. Identifying themes determined by the independent coding of the same source documents is an accepted method for qualitative research in social sciences (Armstrong et al. 1997).

Characterizing the Base of the Pyramid

Combined, India, Africa, China, and Latin America/Caribbean (LAC) contain almost two thirds of the people on earth. The populations of these regions are approximately: China = 1.3 billion; India = 1.1 billion; Africa = .85 billion; LAC = .55 billion. Together, they contain a disproportionate number of the poorest people in the world and thus serve as the focus for our study.

There are several ways to describe the development of a country or region from the perspective of information and communication technology "readiness." A country's network readiness index (NRI) score is an aggregate measure of its ability to make use of ICT. It is composed of three major sub-indices – the market, political, regulatory, and infrastructure environment; the readiness of individuals, businesses, and government to use technology deployed; and the actual usage of ICT by individuals, business and government. Each of these sub-indices is decomposed further, and countries receive scores at all levels of indexing. See Kirkman et al. (2002) and Dutta et al. (2003, 2004, 2005). Clearly, NRI is only a composite indicator. India has thriving technology centers in Bangalore and Hyderabad, for example, and primitive infrastructure and use of ICT in many other locations. For Africa, the situation may be regarded as more heterogeneous since countries, not continents, are given NRI scores. The ranks of NRI scores for the regions we are considering among the 115 included in the latest evaluation are:

[1] It should be noted that this example is provided only to illustrate the coding scheme. The database contains a very diverse list of projects and not all of them fit into this archetype.

Table 4. NRI Score 2005 – 2006	
Region	Rank
India	40
China	50
Latin America/Caribbean (LAC)	Median rank 72.5
Africa	Median rank 87.5

NOTE: Not all African countries have received an NRI score nor have all LAC countries. Median ranks reflect only those countries with rankings.

Africa and LAC each contain a highly disproportionate number of countries with the very lowest network readiness ranks. The ten lowest ranked countries include: Benin (108), Guyana (111), Chad (114), and Ethiopia (115 out of 115) in Africa; and Ecuador (107), Bolivia (109), Nicaragua (112), and Paraguay (113) in LAC. The only countries outside of Africa or LAC among the ten lowest ranked countries are Albania and Bangladesh.
See Table 5.

Table 5. NRI Score Trend 2005 – 2006				
Country	NRI Score	Rank (2005)	Rank (2004)	Change
Albania	-1.04	106	n / a	New
Ecuador	-1.07	107	95	-12
Benin	-1.07	108	n / a	New
Bolivia	-1.10	109	99	-10
Bangladesh	-1.11	110	100	-10
Guyana	-1.11	111	n/a	New
Nicaragua	-1.14	112	103	-9
Paraguay	-1.23	113	98	-15
Chad	-1.36	114	104	-10
Ethiopia	-1.39	115	102	-13

Our previous research has shown that, among countries at or involved with the base of the pyramid, NRI (or its strong correlate, GDP) is a strong predictor of the ways in which a country uses ICT (Gordon, Wang and Hammond, 2005). For instance, countries with low NRI scores are very likely to employ ICT to support agriculture, for computer training, or in telecenters. Countries with higher NRI scores are more likely to be involved in NGO capacity building, cultural preservation, and providing enabling technologies.

Countries can be compared by the penetration (percent usage) or diffusion (change in rate of adoption) of particular technologies. The penetration of the Internet (expressed in number of users per 100) is shown in Table 6 below for the regions of interest: Penetration rates for India and China are found in (Dutta et al. 2005). We have calculated median penetration rates from those same data.

Table 6. GITR Data on Penetration and Dispersion (Summary)	
	Penetration[2]
India	1.6
China	4.6
Latin America / Caribbean	Median 5.6
Africa	Median 0.8

Similar penetration statistics can be produced for other technologies. Some worldwide statistics follow:

Table 7. GITR Data on Global Diffusion of ICT (Soumitra et al. 2004)			
Penetration	World	Low-Middle	Low
Internet Users	10%	5%	1%
P.C.s	9%	3%	1%
Telephone	18%	16%	3%
Cell	19%	15%	2%
T.V.	29%	30%	10%

Diffusion rates tell a different story. Countries with very low penetration rates are adopting technologies rapidly. According to 1999-2002 ITU data, as again reported in (Dutta et al. 2004, Chapter 2) some of the fastest rates of diffusion are in developing countries, though people there still suffer severe problems with ICT access. Rates are non-uniform across countries and regions. China, India, and Africa are all experiencing surging rates of diffusion.

[2] Based on *Internet users per 100 inhabitants, 2002* in GITR 2004-2005

Table 8. GITR Data on Global Diffusion (Percentage Leaders)		
Penetration	Country	Percentage Change
Internet Users	Somalia	44,000%
	Azerbaijan	3,650
	Uzbekistan	3,567
P.C. User	Yemen	383%
	Zimbabwe	300
	Equatorial Guinea	250
Landline User	Somalia	186%
	Sudan	167
	China	97
Cellular User	Syria	9,900%
	Cameroon	9,283
	Albania	7,167

Results

We now turn our attention to analyzing the cases from each of our four regions. As a reminder, our goal is to characterize the cases from our dataset that both to understand more clearly each region and then to make comparisons among them. We are particularly interested in innovation, firm benefits, and local benefits.

Technology, Deployment, and Application

The distribution of cases across the four regions is as follows (Table 9): Although we include China in many tables, its number of projects is too small to include in statistical analyses.

Table 9. Distribution across the Four Regions				
	Africa	LAC	India	China
Number of Projects	304	166	233	16

It is interesting to note the distribution of technologies across regions. India makes significant use of enabling technologies like satellites, handhelds, and solar-powered devices. LAC and Africa provide services predominantly on a community basis through telecenters and portals (specialized centers devoted, for instance, to agriculture). An interesting phenomenon at the base of the pyramid are mobile telecenters, which facilitate a style of store-and-forward communication as an "internet bus" rolls through a rural village once a day and citizens have a brief window for connecting to the internet.

Table 10. Distribution across the Four Regions						
	Enabling Technology	Telecenter	Portal	Rural Telephony	Mobile Telecenter	Radio
Africa	49	82	37	10	5	14
LAC	29	59	34	11	2	5
India	68	57	44	8	5	1
China	3	3	1	1	0	1

The regions differ somewhat in terms of the activities that they use ICT to support. Table 11 provides data for the three regions. Training and education are the most common activities in each of the three regions. Each reflects activity in e-governance, youth services, and school networking.

Table 11 shows that certain activities are common across regions (data are number of instances in the database). Computer training, providing educational services, and more generally serving youth are always prominent. In fact supporting education and training is far more common than offering new healthcare options, especially in Latin America / Caribbean, where it is not among the top activities at all. All regions have a fair representation in the area of e-governance. Latin America/Caribbean leads the way in e-commerce, often in the form of selling local handicrafts, which also helps preserve its culture heritage. India makes the greatest efforts to use ICT to support agriculture (by supplying farmers with price, weather, planting and other information).

Table 11. Distribution of Activities across Regions			
	Africa	India	LAC
Computer Training	142	59	62
Education	103	50	43
Youth	68	28	33
School Networking	42	18	18
E-governance	29	49	15
Job Training	29	14	12
NGO Capacity Building	26	8	16
Empowering Women	26	32	14
Healthcare	25	18	0
Business Services	25	9	0
National Network Development	25	3	0
Agriculture	24	35	0
E-commerce	0	0	20
Cultural Preservation	0	0	14
Handicrafts	0	0	11

The four regions differ somewhat with respect to the sector that is heading ICT efforts at the base of the pyramid. Africa has the highest percentage of efforts headed by non-profits (70%) with LAC close behind (67%). India, in comparison, has fewer than 50% of its efforts led by non-profits, with for-profits making up over 25% of its cases.

Table 12. Projects by Sector

	For-Profit	Government	Non-Profit
Africa	50	40	214
LAC	28	26	112
India	64	60	109
China	1	6	9

There are cross-regional differences in how activities at the base of the pyramid are funded across regions as well. As a possible reflection of the depth of poverty in the region, the majority of efforts in LAC are funded either by international aid or charity. In contrast, aid funds a small fraction of the cases in India (11%), with governments (from national through local) funding nearly one in three efforts. Most interesting is Africa. Fully one-third of the cases where ICT is deployed at the base of the pyramid involve commercial activities where companies, NGOs, or government agencies charge fees necessary to sustain their efforts. In India, there is a sizeable fraction of cases, too. These results suggest that ICT is being used in ways that support commercial transactions – a positive sign in terns of the sustainability of these efforts.

Table 13. Distribution by Funding Source

	Government	International Agency	Philanthropy	Private Investment	Services
Africa	72	132	120	64	219
LAC	49	66	66	38	42
India	103	41	64	76	81
China	8	9	4	1	1

Benefits to Organizations

Arguments about the "fortune at the bottom of the pyramid" are rooted in the premise that the aggregate wealth in very low-income markets ought to provide attractive business opportunities to large companies. In addition, it is argued that firms operating at the base of pyramid will benefit in other ways by being forced to improve their capabilities to operate effectively in a business environment where every penny counts and Western-level infrastructure is the exception, not the norm.

For those cases in the dataset where multinational firms were participating, we coded both the immediate financial benefits they derived as well as and gains in their capability. More specifically, we coded for each case benefits and capabilities at the level of detail shown in Table 14. Though our statistical analyses were at the level of "economic benefits" or "improved firm capabilities," the supporting detail allowed us to better understand and interpret our results. Occasionally, a case without a participating for-profit still showed financial returns or gains in firm capability for a participating organization. In those instances, we included the results in the following two tables.

1) Economic benefits for the for-profit company. These would include increased profits, laying the groundwork for future growth, increasing consumer's abilities to purchase, new product development, and more efficient production.
2) Improved firm capabilities. These benefits to companies included: trialing new technologies, taking business models developed at one base of the pyramid location to another or to the developed world,

finding new ways to reduce risk, design knowledge in the form of dramatic reductions in price-performance ratios, or process improvements.

At the most aggregate level, the distribution of benefits to for-profit companies was as follows:

Table 14. Distribution of MNC Benefits		
	Economic Benefits	Improved Firm Capabilities
Africa	34	38
LAC	28	22
India	42	38
China	0	1

These data tended to confirm that firms that enter base of the pyramid markets can make money and can develop new business practices that make them a stronger organization. This finding holds independently of region.

Benefits to Local Citizens

The 1,048 cases in the dataset were also coded for the benefits they provided to local communities. These "local benefits" could take any of three forms. As with firm benefits, we coded to the level of detail shown. As before, we used the supporting detail in our interpretations of results rather than in our statistical analyses.

1. Product/service benefits to consumers. This would include the introduction of new products or services, better prices, improved choice, and a generally more hospitable business climate for consumers (such as being served with greater transparency).
2. Economic benefits / capacity building. These benefits may result from new employment opportunities or the potential for future opportunities due to skills improvement. They can also include the creation or expansion of local businesses, better access to capital, better access to markets, or local communities receiving a greater share of value created by some end-to-end product or service offering.
3. Social benefits. Such benefits include cultural preservation, empowerment of women, or improvements in health care or education.

The distribution of local benefits across regions is as follows (See Table 15):

Table 15. Distribution of Local Benefits across Regions								
	Consumer	**Economic**	**Social**	**Total**		**Consumer**	**Economic**	**Social**
Africa	165	112	185	462		35.71%	24.24%	40.04%
LAC	70	62	109	241		29.05%	25.73%	45.23%
India	134	86	138	358		37.43%	24.02%	38.55%
China	9	8	11	28		32.14%	28.57%	39.29%

It is striking to note the similarity across regions in the distribution of local benefits. There is very little deviation from a pattern of one-third, one-quarter, two-fifths for consumer, economic, and social benefits respectively. These results suggest how ICT at the base of the pyramid is providing important gains in human (social) infrastructure. In addition, as the subtitle, "Eradicating Poverty through Profits," of Prahalad's (2005) book suggests, as firms enter base of the pyramid markets, they can raise community incomes. The data above suggest that, in addition to

receiving better prices, expanded product offerings, and improvements in essential services such as healthcare and education, one-quarter of the time communities do see economic benefits as well.

Of course, these local benefits can be provided by different sectors. Table 16 below breaks out these benefits by region and sector. It is important to note the key role that the non-profit sector continues to play in providing local communities with not only social benefits, but consumer and economic benefits. In each of these categories, non-profits produce more benefits than either for-profit companies or governmental agencies. This result is true for each geographic region. Of course, there are more NGO efforts at the base of the pyramid than there are for-profit efforts. Still, the results mean that economic development and even improvements in the environment for consumption owe much to non-profits. Conversely, in India, more so than other regions, for-profits and the government play sizeable role in delivering local benefits

When we look at these same data to understand the types of local benefits that each sector affords, the results are again instructive. Naturally, non-profits most often provide social benefits. Though for-profits provide consumer benefits most often (lower prices, more choice, etc.) at least half as often they provide improvement to local economic conditions. In India, the for-profit sector produces benefits across all three categories. Finally, though the government is highly involved in producing social benefits, its efforts produce consumer benefits, too. In India, their role is especially strong and actually favors consumer benefits more than social.

Table 16. Distribution of Local Benefits by Sector and Regions

	Consumer			Economic			Social		
	For-Profit	**Non-Profit**	**Government**	**For-Profit**	**Non-Profit**	**Government**	**For-Profit**	**Non-Profit**	**Government**
Africa	28	111	26	31	66	15	17	143	25
LAC	19	43	8	11	41	10	12	80	17
India	42	51	41	24	46	16	31	77	30
China	1	7	1	0	4	4	0	5	6

Relationship between MNC Benefits and Local Benefits

Hart (Hart 2005) and others forcefully argue that companies are well equipped to deliver local benefits to communities in developing markets; but for companies to remain interested in the opportunities there, they must operate in their self-interest. In other words, *sustainable* local benefits are most likely from firms that themselves benefit from, and produce benefits for, local communities. Along these lines, we calculated the extent to which local benefits (either consumer, economic, or social) are associated with benefits to for-profit companies (economic benefits or improved firm capability). Using logistic regression, we calculated the degree to which local benefits were predicted by benefits to companies. The key results from these calculations are in Table 17. Only statistically significant results are shown.

Table 17. Relationship between Local Benefits and MNC Benefits				
	Response	**Predictor**	**Probability**	**Notes**
Africa	Local consumer benefits	MNC economic benefits	< 0.05	
LAC	Local consumer benefits	MNC economic benefits	< 0.05	
India	Local consumer benefits	MNC improved firm capability benefits	< 0.05	
	Local social benefits	MNC improved firm capability benefits	<0.01	Inverse relationship

We see that economic benefits that accrue to local communities are not correlated with economic benefits that accrue to companies in any region. This may be due to the limited number of cases in total where local communities receive the economic benefits of job creation, business creation, greater market access, etc. Or it may be an indication of the difficulty of fulfilling the promise of a self-sustaining virtuous cycle where they are involved in activities that both benefit themselves and produce local economic benefits as well.

It is interesting to note, however, that in all three regions, when consumers were benefiting, so were companies in *some* way. In Africa and Latin America/Caribbean, MNCs' economic gains were associated with local consumer benefits (but not local economic benefits). Thus, we speculate that the form of economic benefits most often occurring were benefits to the firm like more efficient production, new product development, or similar benefits that would *not* produce economic benefits for locals.

In India, on the other hand, consumer benefits tended to arise relatively more often from firms' experiments with new technologies, radical re-design or products, or changes in the processes they follow. Finally, social benefits in the areas of health, education, empowerment of women and cultural preservation were very *un*likely to accompany Indian companies' attempts at improving their firm capabilities.

Innovation

The data we analyzed are also useful for exploring how computer and communication technology supports innovation. The data indicate how ICT led to innovations in four high-level categories: organizational innovations; product/service innovations; primarily technological innovations; and value chain innovations. These were distributed as follows:

Table 18. Distribution according to Innovation				
	Organizational	**Product / Services**	**Technological**	**Value Chain**
Number of Projects	236	136	521	155

Organization innovations were composed of those providing managerial leverage (218 cases) and those allowing new sources of contracts (18 cases). Of the 218 cases involving improved managerial leverage, most involved leveraging ICT for training (116) or to support new partnerships (78). The remaining cases helped build local credibility and supported franchising.

Product / Service innovations (136 cases) mainly involved changing the size, dimension, features, or language of an offering, or establishing an entirely new product category. Technology innovations (521 cases) typically involved

extending communication or providing or providing new means for accessing information. Value chain innovations (155 cases) almost always involved changes in product distribution, and these changes were almost always more "informational" than physical in nature.

We were interested in exploring how different technologies facilitated these different forms of innovation. To do so we again performed logistic regressions. Statistically significant results are shown below, by region:

Table 19. Relationship between Innovation and Technologies

	Response variable	Predictor	Probability	Notes
Africa	Organizational innovations	Enabling technologies	< .05	Inverse relationship
	Product / Service innovations	Telecenter	< .05	
	Improved communication / info. innovations	Enabling technology	< .05	
LAC	Organizational innovations	Enabling technologies	< .05	Inverse relationship
	Improved communication / info. innovations	Enabling technology	< .01	
India	Organizational innovations	Enabling technologies	< .01	Inverse relationship
	Organizational innovations	Telecenters	< .05	Inverse relationship
	Improved communication / info. innovations	Enabling technology	< .05	
	Value Chain innovations	Portal	< 0.01	

These results show that advanced "enabling" technology such as satellite or solar-powered are rarely used to support organizational innovation. Using ICT for training workers and supporting new partnerships (the most common occurrences of managers' extended leverage) does not seem to require sophisticated technology. The same is true for telecenters in India. On the other hand, advanced technology does facilitate improved communication and exchange of information. Telecenters (in Africa) provide a means for delivering new (education and training) product / services and themselves represent a new service. And changes to firms' value chains in India are associated with portals (such as agricultural portals that link farmers with those buying their products).

Relationship between Innovation and Benefits

Table 20 indicates how different forms of ICT-enabled innovations may support or possibly even interfere with providing social, economic, or consumer benefits to local communities. In Africa, when organizations use ICT for innovations in training or partnership formation (the two main instances of organizational innovations), the local economy tends to improve. On the other hand, ICT that supports mainly technology-focused innovation is negatively correlated with improvements to the economy. This suggests that technologies used for extending communication or providing better information (chiefly technological innovations) by themselves won't produce local economic benefits. Technology-focused innovations tend to bring about social improvements, however.

In India the situation is a bit different. Technology-focused innovations again are negatively correlated with local economic benefits. But here we see that value chain innovations (often affecting the informational aspects of the distribution of goods) indicate the absence of societal benefits. This result suggests the "business-only" uses of ICT to support more streamlined operations without societal "frills."

Table 20. Relationship between Local Benefits and Innovation				
	Response	**Predictor**	**Probability**	**Notes**
Africa	Local economic benefit	Organizational innovations	= 0.05	
	Local economic benefit	Technological innovations	< 0.05	Inverse relationship
	Local social benefit	Technological innovations	< 0.05	
LAC	NA	NA	NA	
India	Local economic benefit	Technological innovations	< 0.05	Inverse relationship
	Local social benefit	Product / service innovations	< 0.05	
	Local social benefit	Value chain innovations	< 0.05	Inverse relationship

Conclusion

We have tried to take an empirical look at the ways that information and communication technology is being used in four regions that collectively comprise almost the entirety of the "base of the pyramid." These regions are India, Latin America/Caribbean, Africa, and India.

Researchers trying to understand the complex interplay between organizations, technology, business models and processes, benefits, and innovations have a daunting task. Taking account of all the important detail surrounding any one instance where these factors above come into play (as is done in well executed case studies) raises questions of whether findings can be generalized. Case studies certainly can indicate what is possible, what is difficult, and they may suggest questions that require more careful examination.

How can such examination be done? Studies focusing on national or regional data are certainly one way. There are well-honed ways to measure national (regional) income, technology penetration and diffusion, and business productivity. But these data may not capture enough of the variation within the country or region to provide a clear understanding, either. Where case studies are too refined and detailed, macro-level statistics are not detailed or refined enough.

We have presented a third way: analyzing a large set of hand coded examples. The examples we have analyzed were the complete set of cases captured by a prominent research institution tracking activity and information and communication technology at the base of the pyramid. Nonetheless, there are clearly problems with the data in the dataset. Its collection derived from scanning all available resources such as newspaper and magazine articles, press clippings, etc. And these introduce a bias for success: Though flaming failures of big companies may make good copy, failures at the base of the pyramid are less compelling than are successes. In addition, what is reported may confuse actual and intended innovations and benefits, which can confound coding.

Two observations make these objections less severe. First, a sample of one thousand cases is likely to be suggestive of what is occurring at the base of the pyramid. Though cases resulting in failure may differ in some ways, they likely share many more characteristics with those in the dataset we examined. Second, the dataset can be considered the universe of analysis. In this sense, what we may be more rightly asking is: what relationships hold among those base of the pyramid cases that result in *some level of success*? Among these cases, what is the relationship between benefits to companies and to local communities? Between organizational innovations and economic benefits? The

approach is not too different than what we do in analyzing CRSP tapes to make generalizations about "business performance," even though the tapes are only representative of a very certain type of business. Our task is to use the data that are available and strive to explain them. As we begin to ask and answer questions, we must be sure to regard our answers as clues – not definitive conclusions.

From the themes that emerge, we can begin to explore new questions and issues, such as these: Since ICT is used to support education before all other activities in every region, what are the differences among methods used for education and the different effects they produce? Do effective methods transfer across regions? Or: since benefits to local communities are more commonly produced by NGOs than businesses, in what circumstances is business better suited for providing them? Or, at the country level: why do Indian firms' attempts to develop new product design knowledge or trial new technologies so rarely produce positive social benefits?

There is a strong need to ask the right questions and use appropriate methods for doing so. Our hope is that we have succeeded in encouraging others to join the quest and that our methods and results will provide guidance. Developing new knowledge about how to serve the under-served is much more than an academic exercise.

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