Testing a Recent Model of ICT in Development: Botswana and Its University

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ABSTRACT

A recent model analyzing the role of information and communications technology (ICT) in development shows promise. The model coheres with theory on contingency, the problem of reductionism, and distinctions between deeply and shallowly inscribed organizational change arising from ICT. Conditions of e-readiness at the University of Botswana provide an opportune case study for the model. On the whole the original model holds up well, although the case study reveals relevant factors missed by the model: underlying support infrastructure and postimplementation growth in demand. Accordingly, we define an explicit role for time in the model and add a major new dimension of financial sustainability. These additions equip the model to better account for realities affecting ICT's role in development. Further research needs include case and cross-case studies of the revised model.

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1. INTRODUCTION

Maung K. Sein and G. Harindranath (2004) have published a model analyzing the role of information and communications technology (ICT) in national development. They aim to correct a view of ICT as a monolithic or homogeneous "artifact" (p. 17)—a view that hinders understanding of "exactly how ICT affects national development" (p. 15). Thus, their original contribution is to unpack ICT as a development tool, both to understand it better and to improve its usefulness. In section 2, we present the Sein and Harindranath (S-H) model in detail.

Richard Heeks' (2002) work on contingency theory reinforces the need for the S-H model. Heeks explains that factors influencing the success of ICT implementation tend to be "situation-specific" (p. 103) or contingent. When technology is introduced, there is danger of a lack of fit between the "tool" and the "task," a "design-actuality gap" (p. 103–104).

Why is a generalized model needed if situation-specific factors are of prime importance? Contingency and models could be seen as opposite approaches, although they are actually complementary. Heeks reports a failure rate of 20–25% among ICT installation attempts in developing countries (p. 102). The S-H model's is tailored to categorize situation-specific problems from separate projects and thus to fit apparently isolated problems into patterns, an important start in avoiding future setbacks.

These projects, for example, report troubling contingencies:

- The risk of disempowerment arises when technology planners fail to account for user expectation (Morales-Gomez & Melesse, 1998; Heeks, 2002, p. 104, 106).
- ICT can flounder for lack of adequate training and support (Fonseca, 2001, p. 404).
- A project failed owing to theft of hardware left unsecured in proximity to low-income communities (Andrew & Petkov, 2003, p. 82).
- A project overlooked social context to its detriment when it attempted to install hardware without regard for a region's traditional authority structure (Andrew & Petkov, 2003, p. 83).

Successful projects, too, demonstrate contingency:

- If a user population is particularly motivated to succeed, it can overcome a degree of inadequate technical infrastructure (Simpson, Lennie, Daws, & Previte, 1998).
- The well-known Grameen cellular telephone project in Bangladesh fostered certain social structures that in turn fed back and reinforced gains by the technology (Sein & Harindranath, 2004, p. 21).

The model potentially applies pattern to contingency. Pattern, in turn, conveys context. Belotti, Decurtins, Grossniklaus, Norrie, and Palinginis (2004) emphasize context as needed to "facilitate general implementations" because context is "the driving force behind our ability to discriminate what is important and what is not." Expressing this as succinctly as possible, the Director of Evaluation of the International Development Research Centre (IDRC) of Canada, with two major ICT projects in Africa (International Development Research Center, 2006), observed, "Context matters" (Carden, 2004, p. 150).

The question is not only whether the S-H model is needed and is sufficiently pervasive for broad application but also whether the model is optimized. Its authors present it as a work in progress and invite testing (Sein & Harindranath, 2004, p. 22). Accordingly, we accept the invitation, with the University of Botswana (UB) as a case study.

Through a case study of the S-H model, we aim to

1. test its applicability to the implementation of ICT at UB,
2. learn thereby the model's strengths and weaknesses, and
3. refine the model and optimize it for further use.

1.1 The Status of E-Readiness at the University of Botswana

At this southern African university, the installation and operation of ICTs have brought considerable benefits such as e-learning, student records systems, distributed access to online databases in and beyond the library, new curricular content, and upgraded faculty research. Nevertheless, as published in documented detail by these authors (Gerhan &

Mutula, 2005), ICT at UB has performed less well than it has elsewhere. Poor Internet connectivity and slow speed lie behind crowding, delay, and frustration at many stages of a student's career and affect UB faculty and administration as well. An update of the ICT situation affecting UB follows.

The World Bank continues to rank Botswana among the world's upper-middle income nations along with the Czech Republic, Malaysia, Mexico, and others. (World Bank, 2005, inside cover page). However, economic indicators for the cohort and most of its members surpass Botswana's. For example, Botswana's population is 49.9% urban in contrast to the much higher 75.1% mean of the cohort. Illustrating further, inhabitants of Botswana own 30 televisions per 1,000 persons; the average for the cohort is ten times as many.

Botswana is advancing. Its GDP grew by 6.4% in the spans from 1990–1995 to 1995–2002, compared to 2.5% in the other upper-middle income countries (World Bank, 2004). The World Economic Forum ranks Botswana as Africa's "best performing" economy (Ifinedo, 2005). It has achieved gains by other measures, like free access to education, universal health care, professionally educated management for the economy, and reduction of corruption. (Ford, 2005; Gaolathe, 2005, p. 1).

As shown in Table 1, however, Botswana's public expenditures for education lag behind those of selected cohort members of its cohort, the cohort in aggregate, its neighbor South Africa, and the U.S.A.

Specific to e-readiness, in Internet connectivity Botswana stands in striking contrast to high-income countries. The total bandwidth for Internet traffic in and out of Botswana recently amounted to 26 megabits per second (Mbps), in contrast to nearly 382,000 Mbps available to the USA (International Telecommunication Union, 2003, pp. A70–A71; International Telecommunication Union, 2004, p. A19). Botswana has about 1.7 million inhabitants and the USA about 296 million (Infoplease, 2005). Thus, bandwidth availability works out to roughly 15 bits per inhabitant of Botswana compared to more than 1,300 bits per inhabitant of the USA, or 87 times as much bandwidth per person in the USA as in Botswana.

Historically, bandwidth availability both in Botswana and in the USA has grown since 1999 levels, with faster growth in Botswana. In 1999, bandwidth could be computed to

TABLE 1. Public Expenditures on Education as Percentage of National Budget (Rounded by source)

Country	1998	1999	2000	2001	2002
Argentina	4	5	5	5	4
Botswana	–	–	2	–	–
Chile	4	4	4	–	4
Czech Rep.	4	4	4	4	4
Hungary	5	5	5	5	6
Malaysia	5	6	6	8	8
Mexico	4	4	–	5	5
Poland	5	5	5	6	6
Saudi Arabia	8	–	–	–	–
S. Africa	6	6	5	5	5
USA	5	–	6	6	–
Upper Middle Income Group (Aggregated)	4	4	4	4	5

only 0.4 bits per inhabitant of Botswana, compared to about 83 bits per inhabitant of the USA (eMarketer, 2001, p. 72, 222). Although that meant 208 times more bandwidth per inhabitant in the USA than in Botswana, the gap has narrowed considerably to the more recent 87 times (above paragraph).

Moore (2000, p. 40) stated, "We are experiencing a bandwidth explosion." In 2000, broadband was growing globally at a factor of ten times per year while dropping in cost by 15% per year (p. 40). Botswana represents a developing country that has thereby benefited, although the gap between high-income cohort countries and others continues.

Comparing campuses alone, UB has 14 Mbps of bandwidth for Internet access, a level far less than at the American college with which one author is affiliated. At this writing, Union College, with only about one-seventh of the students of UB, has 80 Mbps of bandwidth access to the Internet—this amount is more than five times that of UB, as well as over three times the bandwidth available to the entire nation of Botswana (International Telecommunication Union, 2004, p. A19).

Off-campus insufficiencies of bandwidth exacerbate shortages at UB. Gerhan and Mutula (2005) trace bottlenecks to bandwidth shortages in Africa-wide access to the Internet, regulatory inefficiencies hindering African networks, and shortages of fiber-optic cabling.

In new examples, UB has been hindered in Web-based cooperative distance learning projects with the University of Southern Maine and the University of Georgia (USA). Similarly, recent research on e-readiness of small and medium-sized business enterprises (SMEs) confirms that bandwidth shortages are experienced beyond UB (Mutula, 2005, chap. 5, p. 2). SMEs in Botswana complain of "the high cost of bandwidth," "frequent Internet downtime," "slow Internet access speeds," and "frequent dropped connections." Business people who were interviewed made the following statements:

- "Bandwidth providers are cheating us by selling high bandwidth which we don't achieve."
- "My next door neighbor purchased high bandwidth but there is still no improvement in data transmission rate."
- "Everybody is complaining of bandwidth, even those who have broadband access." (chap. 5, p. 15)

Besides the supply problem, there is also one of demand. UB's rapid growth heavily burdens its ICTs. The university reached its 15,000-student goal four years too early, and a second university is scheduled to open in 2009, further burdening network resources and degrading response time.

The national government of Botswana has demonstrated its intention to place a high priority on ICT support. In U.S. dollars, investment allocation for ICT has grown from four million in Botswana's 1992–1997 economic plan, to 97 million in its 1997–2003 plan, to 120 million in its latest 2003–2009 plan (Department of Information Technology, Botswana, 2005). However, competing demands have hindered public investment in ICTs. Botswana faces accelerating costs owing to the HIV/AIDS epidemic. The Minister of Finance has put a hold on funding to UB for any projects still in the planning stages (Gaolathe, 2005, pp. 23–24).

Finally, management inefficiencies and financial losses have slowed capacity-building efforts by the Botswana Telecommunications Corporation (BTC). Hopes are high for reversing this under new management, but the BTC has, to date, reported profit only through a one-time bookkeeping technicality.

However, there are reasons for optimism. Studies of e-readiness rank Botswana among the leaders in Africa (Ifinedo, 2005). Regulatory rigidity in Botswana is loosening. For instance, BTC has initiated digital subscriber line (DSL) networking to replace dial-up access in the capital Gaborone with extension to other areas soon (ITEC Group, 2005, p. 1). Capabilities like peering among Internet hosts, flexible message routing, and Voice over Internet Protocol (VoIP) to enable online telephoning are now on the horizon. These changes could address problems with distance learning projects at UB, as cited earlier.

In 2004, the Botswana government introduced a national ICT plan known in Setswana as *Maitlamo* and linked it with a "Connecting Botswana" effort to design "adequate, affordable, reliable, and sustainable ICT infrastructure ... to enable full connectivity and the delivery of health, education, public services, and e-commerce solutions to everyone in the country" (Botswana Press Agency, 2004; Balancing Act, 2005). In the face of competing demands on public revenues, particularly HIV/AIDS related, *Maitlamo* urges private investment in joint public/private effort toward ICT advances. The private sector is to provide the bulk of the funding, and the government will encourage a friendly regulatory climate. To that end, the Minister of Finance and Development committed to ICT liberalization in his budget address before the National Assembly (Gaolathe, 2005, p. 16). However, the "Connecting Botswana" effort will require patience, as its completion is scheduled for 2017.

The generous provision of hardware, software, and fiber-optic networking achieved by UB perches precariously on a fragile platform beyond the campus and the university's control. Hopeful signs of progress appear, but its pace is slow.

2. THE SEIN-HARINDRANATH MODEL OF ICT IN DEVELOPMENT

There are three principal levels in the S-H Model, shown in Table 2a.

Each level's aspects (i.e., components) clarify its meaning. Table 2b indicates that "How ICT is used" can be broken down into four aspects:

- commodity
- supporting development activity
- driver of the economy
- directed at specific development projects

Descriptions by Sein and Harindranath appear in Table 2b in order to clarify and expand upon these aspects.

Table 2c displays the aspects in Level 2 of the S-H Model ("How ICT is viewed"):

TABLE 2a. Overview of the Sein-Harindranath Model

How ICT is used
How ICT is viewed
How ICT impacts development

TABLE 2b. How ICT is Used (Level 1, S-H Model)

Aspects	Expansion/clarification
Commodity	"ICT is seen as a commodity, or product to be used to earn foreign currency through export."
Supporting development activity	"ICT helps in activities related to development, e.g., planning, management, training."
Driver of the economy	"ICT is conceptualized to have a macro-level influence, e.g., in infrastructure, education, [and] the private sector."
Directed at specific development projects	"ICT is conceptualized as having developmental impact within the context of targeted initiatives."

Note. From Sein & Harindranath, 2004, p. 17–18.

- nominal
- tool
- computational
- proxy
- part of an ensemble

Descriptions by Sein and Harindranath appear in Table 2c in order to clarify and expand upon these aspects.

The third level of the S-H Model ("How far-reaching are the changes ICT brings") is shown in Table 2d. The model suggests three aspects of change:

- 1st-order
- 2nd-order
- 3rd-order

Table 2d clarifies and expands upon these aspects.

2.1 The Model in the Context of Organizational Change Literature

The S-H model relates to more than contingency theory regarding the role of ICTs in development. Andrew and Petkov (2003) address ICT planning that places too much emphasis on "the end result, the ultimate payoff," as well as the "hard engineering aspects" (p. 76). Not only is there a tendency to "standardize on technology" (p. 80) but also (and worse yet)

TABLE 2c. How ICT is Viewed (Level 2, S-H Model)

Aspects	Expansion/clarification
Nominal	"Only as the object of study and no specific view is articulated."
Tool	"ICT is conceptualized as an engineered artifact."
Computational	"ICT is conceptualized purely as technology and the algorithms, codes, and models that comprise the system."
Proxy	"ICT is conceptualized in terms of a surrogate for some other concept [or] 'what ICT represents.'"
Part of an ensemble	"ICT is conceptualized as part of a bigger 'package' going beyond the technology."

TABLE 2d. How Far-reaching are the Changes ICT Brings (Level 3, S-H Model)

Aspects	Expansion/clarification
1st-order	"The first-order or primary effect is simple substitution of old technology by the new."
2nd-order	"The second-order or secondary effect is an increase in the phenomenon enabled by the technology."
3rd-order	"The third-order or tertiary effect is the generation of new technology-related businesses and societal change."

Note. From Sein & Harindranath, 2004, p. 19.

to rely on "off-the-shelf technologies ... providing a well-known and tested solution for a problem that is not deeply understood" (p. 89). Andrew and Petkov generalize these errors as "the common reductionist tendency" of regarding "the technological subsystem as the whole" (p. 86).

The S-H model counters such reductionism through broadly considering the indirect effects of ICT, for example, as an economic influence or development enabling. The model accounts for ICT's role in still broader fashion, showing that ICT proxies for intangibles or acts in ensemble with other forces bringing educational or community innovation. Thus, the S-H model is a promising remedy for reductionism, focusing beyond technology alone.

Heeks (2002) theorizes about "deeply and shallowly inscribed" development (pp. 108–110). Deeply inscribed applications bring change to "processes, values, competences, systems, etc.," like decision support systems (DSS) in management or teaching methods. Shallowly inscribed applications involve less systemic change, like replacing typewriting with word processing. The S-H model makes this distinction concrete in its Level 3. *1st-order* and *2nd-order* change correspond with shallow inscription. *3rd-order* change, marked by the appearance of entirely new economic or social activity, represents deep inscription. The S-H model ties into inscription, reductionism, and contingency—three important strains of theoretical scholarship on ICTs in development.

3. CASE STUDY METHODOLOGY

Social scientists have debated comparative strengths and weaknesses of the case study method versus survey research (Stoecker, 1991). They largely accept that case studies may be less appropriate "for statistical inference to larger populations" but are valued for contributing to theory (Smelser & Baltes, 2001, Vol. 3, p. 1509). The strength of the case study rests upon the case being "typical of cases of a certain type, so that through intensive analysis generalizations may be made which will be applicable to other cases of the same type" (Theodorson & Theodorson, 1969, p. 38).

This case study aims at discovering whether generalizations arise in the context of ICT at UB that are applicable to similar cases. Methodological components include

- case selection,
- data collection, and
- reasoning.

3.1 Case Selection

The case selection of UB rests in part upon the authors' connection as lecturers there with ensuing knowledge of, and perspectives on, local conditions. This connection notwithstanding, UB offers a relevant and interesting setting. Sein and Harindranath aim their model at ICT and national development. UB is currently the only university in Botswana (although plans are progressing to open a second). As Botswana's sole setting for higher education, UB represents that country's mainstream for knowledge-seeking and educational empowerment linked directly to development. The link between knowledge, education, and development is "well-established" (Morales-Gomez & Melesse, 1998). Thus, Botswana's national university represents a principal locus for the nation's development and qualifies as "typical of cases of a certain type" (Theodorson & Theodorson, 1969, p. 38), i.e., important arenas for national development.

Few other articles have yet to base their work upon the recent S-H model. De' (2005, p. 27) selected from the S-H model the aspect of ICT as *part of an ensemble* to examine high failure rates for public sector ICTs in developing countries, emphasizing the political interests of stakeholders as ensemble elements requiring consideration. Frieden (2005, p. 598) selected from the model the aspect of ICT as *commodity* and as *driver of the economy.* These articles evoke the model peripherally; thus, this present article represents the first full case study of S-H.

3.2 Data Collection

Data on user experience and e-readiness in UB and its setting represent the independent variables for this case study. Data sources are as follows:

- several datasets, published or cited by the authors, reporting student ICT usage at UB (Gerhan & Mutula, 2005);
- various data gathered and reported since Gerhan & Mutula, 2005;
- firsthand ICT-related experiences of the joint authors while serving on the faculties of UB (authors Gerhan and Mutula) and Union College (author Gerhan), as well as experiences reported by other colleagues;
- quantitative measures of network performance at UB and in Botswana; and
- perspectives of author Mutula as a working member of the national ICT-policy team of Botswana.

3.3 Reasoning

Empiricism and theory converge in case studies, in that empirical data from the case may reshape theory brought to the case. Accordingly, this study poses the null hypothesis that the S-H model describes and explains, accurately and comprehensively, empirical phenomena of the introduction and operation of ICTs at the University of Botswana. The S-H model's three levels (subsection 2.1) are the study's variables expressing how ICTs are used, viewed, and their impact. However, for this case study, testing the null hypothesis (subsection 3.2) is not a quantitative procedure but an evaluation of whether and how well the model variables conform to the actuality at UB. This approach is qualitative and of the "congruence testing" type, an examination of "whether the prediction a theory makes in a case, in view of the values of the case's independent variables, is congruent with the actual outcome of the case" (Smelser & Baltes, 2001, Vol. 3, p. 1515).

Both deductive and inductive methods operate. The study deduces from theory (the S-H model) the ways in which ICT affects development. The study also induces from observing ICTs at UB how well the S-H model accounts for them. The observations determine whether the model needs additions, deletions, or both. The case study is "heuristic" in that the interactions between setting and theory can "suggest possible new theoretical tasks and generalizable principles" (Stoecker, 1991, pp. 99–100). In the end, the aim is to optimize the model's utility for understanding, planning, and evaluating similar projects in the future.

3.4 The Case Study: How the S-H Model Applies at UB

Level 1 of the S-H model is "How ICT is used." The four aspects shown in Table 2b are listed below, with definitions of each abstracted from Sein and Harindranath (2004), accompanied by analysis of each aspect's applicability to UB:

> ***ICT as commodity:*** "ICT is seen as a commodity, or product to be used to earn foreign currency through export" (p. 17).

This aspect of the model is not central to the educational mission at UB; education is not essentially a commodity. Nevertheless, there are senses in which the model's *commodity* aspect is observable and relevant. Graduates who are competent with ICTs become a desirable product to employers. Faculty may use ICTs to publish copyrighted works or patent inventions in which the university may hold proprietary interest. Faculty (or their grants) may be charged back for using the university's ICTs to host their own workshops beyond their regular teaching. UB uses its Web site to market its programs, successfully winning foreign students and currency. UB has established a cyber café that brings in revenue, as do the sales of hardware and software to students and others. Income from these streams offsets substantial expenditure on ICTs from UB's operating budget.

> ***ICT as supporting development activity:*** "ICT helps in activities related to development, e.g., planning, management, training" (pp. 17–18).

Supporting development activity is applicable because ICT drives UB's administrative procedures, and they in turn support the chief educational and development mission of the university: teaching and research. In illustration of this are the automated functions of the registrar and comptroller departments constituting the management information system (MIS) in use at UB.

> ***ICT as driver of the economy:*** "ICT is conceptualized to have a macro-level influence, e.g., in infrastructure, education, [and] the private sector" (p. 18).

Like other institutions, UB experiences market forces, and it has sought economies through installing ICTs. Examples include the MIS that aids administration, departments, and individual lecturers at UB. Faculty and staff utilize electronic student rosters and accounting reports. Lecturers enter marks (grades) through an automated records management system. In the long view, the student body of 15,000 represents a future economic engine made more powerful through ICT capabilities.

Productivity measures are relevant to economic impact, although when applied to the academic sphere, they tend to be more qualitative than quantitative. However, signs of increased productivity are as follows:

- Students receive computerized notice of their marks and standing, communicate with lecturers through the Web Course Tools (WebCT) classroom management system and thus are more quickly informed of their performance than before the advent of ICTs.
- One report estimates that research and publication turnaround times for faculty have speeded up by a factor of four compared to pre-ICT days (Waswa, 2006).
- Graduate students complete their dissertations at a higher rate (Waswa, 2006).
- Employment of secretaries has been somewhat reduced, given the desktop capabilities of academic staff (Waswa, 2006).

Other evidence of productivity is mixed:

- Registration each semester, which formerly required most students to queue overnight, remains painstakingly slow even with ICTs.
- The authors can attest firsthand that computer-based student records are not flawless.
- Online instruction reportedly requires more time from lecturers, than did their earlier methods, in the areas of design, delivery, and administration of courses as well as answering students' frequent questions (Mutula, Kalusopa, Moahi, & Wamukoya, 2006).

Gradually, problems cited may ease. Even with a record of mixed productivity, the S-H model aptly describes ICTs at UB in this *driver of the economy* aspect.

> ***ICT as directed at specific development projects:*** "ICT is conceptualized as having developmental impact ... within the context of targeted ... initiatives" (p. 18).

Here, the S-H model's Level 1 is still more relevant. Teaching, learning, study, and research are all assisted through these ICT gains:

- the availability of digital scholarly publications and the capability for electronic search and retrieval;
- classroom communication through WebCT as well as e-mail;
- empowerment of writing through word processing;
- curricular enrichment through new subjects like records management, geographic information systems (GIS), digital libraries, knowledge management, operations research, computer science, computer-assisted design (CAD), etc., and
- collaboration in teaching and research with foreign universities.

A quantitative study of the impact of online information on information literacy competencies in UB's Department of Library and Information Studies reported a pattern of overall improved performance by most students, a gain from ICT at an intellectual level (Mutula, Kalusopa, Moahi, & Wamukoya, 2006).

Level 2 of the S-H model corresponds to "How ICT is viewed." The following definitions of each of the five aspects, as shown in Table 2c, are abstracted from Sein and Harindranath (2004), and accompanied by a commentary on each aspect's applicability to UB:

> ***Nominal* view:** "ICT is viewed only as the object of study and no specific view is articulated" (p.18).

Sein and Harindranath (2004) de-emphasize this view on grounds that it is merely a theoretical but not a significant aspect. In their remarks about the nominal view, they add, "The term 'ICT' could well be replaced by any other concept, say, 'human resource,' without changing the substance of the study to any great extent." We find no point in the application of the nominal view to the UB case.

> ***ICT as tool:*** "ICT is conceptualized as an engineered artifact" (p. 18).

UB certainly uses ICTs as a tool. Several examples cited earlier under ICT as *directed at specific development projects* are also ways in which ICT provides tools for academic work. In particular these included

- the availability of digital scholarly publications and the capability for electronic search and retrieval;
- classroom communication through WebCT as well as e-mail;
- empowerment of writing through word processing; and
- curricular enrichment through new subjects like records management, geographic information systems (GIS), digital libraries, knowledge management, operations research, computer science, computer-assisted design (CAD), etc.

Selected examples from ICT as *commodity,* previously mentioned, make sense here in this aspect as well: For example, ICTs could also be considered a *tool* at UB by enabling the graduation of more employable individuals, more faculty publications, and a higher profile and reputation for UB abroad.

> ***ICT as computational:*** "ICT is conceptualized purely as technology and the algorithms, codes, and models that comprise the system" (p. 18).

The first three bulleted items above refer to digital applications that have supplanted manual procedures (for example, word processing instead of typing). Thus they illustrate and confirm the computational aspect of the model as well as the tool aspect.

> ***ICT as proxy:*** "ICT is conceptualized in terms of a surrogate for some other concept ... [or] ... 'what ICT represents'" (pp. 18–19).

Beyond its role as *tool,* etc., ICT at UB proxies for the modernization of education and the nation. To be taken seriously, a university strives to be state-of-the-art. Many employers favor graduates with technological competencies. Likewise, graduates hope to become more competitive through university education.

Evidence points to another proxy role for ICTs. Like students everywhere, social-minded UB students reportedly judge their peers by the "three Cs": cash, car, and cell phone (Mutula; Komanyane; & Grand; 2005, p. 81). Whether viewed seriously as a life skill or popularly as a status symbol, ICT's presence on campus serves as *proxy* for modernization.

ICT as part of an ensemble: "ICT is conceptualized as part of a bigger 'package' going beyond the technology" (p. 19).

The adoption of ICTs by UB goes well beyond technology alone. ICTs have been more than aids to teaching and research; they have reshaped them. ICTs have led UB into

- new subjects to teach, such as records management, GIS, operations research, computer science, database management, and CAD;
- new teaching methods like hands-on experiential learning replacing traditional lecturing;
- new challenges such as judging the authority of digital information sources, teaching critical thinking, deciding wisely about paper vs. online information, keeping current with discipline-specific peer review, detecting academic dishonesty in its new forms; and
- community building among academic staff, in part facilitated by e-mail. (For example, academics were recently galvanized into action by an administrative move to charge a campus parking fee. Without a single face-to-face meeting, the faculty circulated an online petition electronically to transmit its point of view to UB's administration more quickly than would have been possible before e-mail.)

Such changes give evidence of broad institution-shaping outcomes and confirm ICT as *part of an ensemble.* Though an expected viewpoint, UB's Educational Technology Unit correctly observes a "paradigm shift in teaching and learning" at the institution (News Portal, 2006).

Level 3 of the S-H model corresponds to "How far-reaching are the changes that ICT brings." The aspects shown in Table 2d are listed below with definitions of each abstracted from Sein and Harindranath (2004) and accompanied by analysis:

1st-order change: "The first-order or primary effect is simple substitution of old technology by the new" (p. 19).

- At UB examples proliferate. Among them, the online library catalog replaces the card file once employed for searching the collections of the UB library. Databases of scholarly journal citations, some with full text, replace printed indexes and hard copy. E-mail replaces written communications or office visits. Word processing replaces typewriting. Simulation and database management software replace manual analysis. MIS streamlines registration, student records, and accounts payable.

2nd-order change: "The second-order or secondary effect is an increase in the phenomenon enabled by the technology" (p. 19).

- Course offerings are increasing, research output is rising, and students are able to complete assignments faster than before the Internet and e-mail were available. MIS enables UB to cope with higher enrollments by tracking, storing, and transmitting more records. At the faculty level, a recent blizzard of e-mails discussing the deporting of an expatriate professor far exceeded the number of paper memos that in an earlier era would have been sent. The decision was not reversed, but central to this point is that faculty could discuss matters without time-consuming face-to-face meetings.

TABLE 3. Numbers of Students Enrolled in E-learning Courses at the University of Botswana, 2002-2005

Semester	Enrollment
1st, 2002–03	1722
2nd	1640
1st, 2003–04	3395
2nd	2153
1st, 2004–05	4229
2nd	8157

Note. From Giannini-Gachago & Molelu, 2005.

> In earlier times, faculty relied on department secretaries to mediate communications within and without the university, whether by typing or taking dictation or telephone messages, etc. Much is now undertaken by faculty themselves and at an increased volume and rate.

Table 3 demonstrates the substantial rise in numbers of students participating in courses taught online. Within classroom-based courses, the use of WebCT is on the rise. In the first semester of 2005–2006, the number of courses utilizing this electronic classroom management software grew by 90% over the previous semester, with 66% more student enrollments. Both of these datasets represent a second-order phenomenon increase and, at the same time, a marked pedagogical shift, characteristic of *3rd-order* change (below).

> ***3rd-order change:*** "The third-order or tertiary effect is the generation of new technology-related businesses and societal change" (p. 19).

New and qualitatively different activities provide evidence of *3rd-order* change at UB. New courses in simulation, modeling, quantitative analysis, records management, GIS, and database management update the curriculum. Although these topics represent stand-alone courses taken by some students, they are also built into core courses to equip nearly all students with state-of-the-art methods in business, education, library and information studies, and others. Together with online pedagogies such as those in Table 3, new curricular content reflects how substantially ICTs have impacted UB's academic culture.

Moreover, the new challenges to the university's academic culture that were listed in the *ensemble* view apply here as *3rd-order* change as well: judging the authority of digital information sources, teaching critical thinking, deciding wisely about paper vs. online information, keeping current with discipline-specific peer review, detecting academic dishonesty in its new forms.

Several examples listed in the *driver of the economy* view also illustrate *3rd-order* change. Examples include quicker research and publication turnaround times for faculty and higher rates of completion of dissertations. More than increases alone, these enable a higher institutional priority for research. Also, ICT brings efficiencies that streamline secretarial work and place more control of documents in faculty hands. Multiple examples of *3rd-order* change represent both progress and new issues and challenges accompanying ICT.

4. DELETIONS AND ADDITIONS

4.1 Deletions From the Model in Light of the Case Study

The first aspect of Level 2 is *nominal,* and we recommend its deletion. It is superfluous; it is a "theoretical" but not meaningful possibility, as confirmed by Sein and Harindranath (2004) in their own article (p. 18).

ICT as *tool* and ICT as *computational* in Level 2 are redundant, as suggested by the examples that fit both. Collapsing the two aspects into one would suffice, as would streamlining them, and thus improving the model. By contrast, although ICT as *commodity* and as *tool* may overlap conceptually, they are not identical but serve separate and important purposes in the S-H model.

The same examples apply equally to ICT as *part of an ensemble* from Level 2 and to *3rd-order* change from Level 3. As the overlap occurs on separate levels of the model, revision is structurally more awkward. Nevertheless, the redundancy between the far-reaching roles of ICT as *part of an ensemble* and *3rd-order* change is notable. Since Levels 2 and 3 overall address separate and important issues, leaving both sublevel aspects in the model results merely in a degree of inelegance, not dysfunction.

4.2 Additions to the Model in Light of the Case Study

Despite these few structural flaws, the S-H model effectively describes much of the role of ICT at UB. However, to optimize the model, we raise important factors that the model fails to take into account in the case study and then suggest ways to incorporate their consideration.

ICTs arrive with the rolling out of a new technological infrastructure. However, the performance of the new rests, to an extent, upon the support infrastructure in place. In the case of ICTs at UB, that means the national telecommunications network, how up-to-date it is (copper vs. fiber-optic cabling, for example, or bandwidth) and thus how reliable. Other pre-existing infrastructural factors like regulatory requirements may expedite (or impede) new ICTs. In the same sense that refrigeration supports the safe handling of new medicines, or transportation enables miracle crops to reach markets, support infrastructure for telecommunications serves importantly as "a reliable delivery mechanism for informing and supporting change" (Welsh & Butorin, 1990, p. 312). The situation at UB is a vivid illustration of support infrastructure inadequate to the full functionality of ICT (Gerhan & Mutula, 2005).

This issue necessarily raises the question of which traditional technological stages must be achieved by developing countries (Morales-Gomez, 1998; Fonseca, 2001). For example, mobile telephones have widely reduced the need in many developing countries for building an extensive network of telephone poles and wires (as in Botswana, where mobile subscribers have grown to over 600,000 in the last five years, while the number of landline customers has remained roughly level at 137,000 for the last three). Development may enable some leapfrogging of stages. "It is as if earlier generations had waited for everyone to have shoes before they began to build roads" (Fonseca, 2001, p. 401).

The success of leapfrogging hinges on the particular stage over which the frog attempts to leap. In the case of support infrastructure for telecommunications, the purpose served is key. Rather than building roads for a country without shoes, the more apt comparison is bringing cars to a country before building adequate roads. Botswana's public expenditures for support infrastructure have been characterized as "generous," although without sufficient attention to support and quality (Mutula, 2005, chap. 5, p. 1). The *Maitlamo* plan cited earlier has reported that the support infrastructure for telecommunications in Botswana is "woefully inadequate" (chap. 5, p. 10).

The S-H model does not account for the support infrastructure upon which ICT success depends. Sein and Harindranath (2004) mention the Indian software industry as dependent upon "further linkages with ... the telecommunications sector" (pp. 20–21). Nevertheless, they do not build into their model the necessity for interaction between ICT and support infrastructure.

Support infrastructure has an effect during two related stages: (a) at the start, as a minimum level needed for early functionality and (b) as ICT is scaled up to serve more users and new applications. Because users expect ICTs to succeed quickly, early assurance of pre-existing support infrastructure is critical in order to sustain user expectations. Following installation, user demands grow, in direct proportion to the degree of initial success of the ICTs. Thus, the initial carrying capacity of telecommunications infrastructure for growing ICT applications will suffice less under conditions of more users and heavier traffic. Providing the initial equipment such as computers and Internet ports at the user interface is a necessary but not sufficient condition for a successful ICT project.

Overlooking infrastructural adequacy fits the previously discussed idea of a "common reductionist tendency" to regard "the technological subsystem as the whole" (Andrew & Petkov, 2003, p. 86).

4.3 Building Time Into the S-H Model

We suggest the incorporation of time into the S-H model to reflect consideration of support infrastructure at the outset of an ICT application. Infrastructure supporting ICTs includes the national, continental, and intercontinental telecommunications backbones analogous to refrigeration in support of medicine or transport in support of agriculture, discussed previously. Level 3 ("How far reaching are the changes that ICT brings") is a naturally fitting place for the purpose. Sein and Harindranath imply an unstated chronology from *1st-order* to *2nd-order* and to *3rd-order* change. A startup or *preliminary phase* aspect fits well into the beginning of this sequence.

In the situation at UB (subsection 1.1), ICTs arrived with insufficient consideration of adequate support infrastructure. In such a *preliminary phase*, prototype projects can succeed. However, scaling ICTs up to the level of utilization by any number of UB staff or students at the time of their own choosing represents transition to the *1st-order* category in the model. The documented difficulties with that transition at UB underscore the need for a *preliminary phase* aspect in Level 3 of the S-H model. Making explicit that the requirements for transition from *preliminary phase* to *1st-order* functionality better serve planners and users.

These four time-ordered aspects of Level 3 may overlap in a setting like UB. There—the later at night and the earlier in the morning—the better the network operates. ICT users in an organizational setting, like a university, typically have more flexibility than in others like government or business. The student's and faculty's work hours tend to vary more than those of office workers. Nevertheless, preferred hours for study and research realistically are less than "24/7," and indeed the labs at UB are closed to students at night. Complaints that "the system is down" during periods of opening from early morning till evening at UB are frequent, along with reports of severely slow response time. Thus *preliminary phase, 1st-, 2nd-,* and *3rd-order* change can and do appear differently for different users at different times. Until ICTs can be scaled up to a level of performance that consistently satisfies users' needs nearly all the time, the *preliminary phase* aspect still prevails despite flexible academic work patterns. Together, the four phases convey time sequence logic that better suits the S-H model to explaining the positive but uneven advance of ICT under realistic case study conditions.

4.4 Building Financial Sustainability Into the S-H Model

ICT successes ideally generate an upward spiral of demand and positive advances corresponding to the aspects of the model. How those growing demands upon ICTs are met—and financed—is key here. The S-H model would benefit from factoring in financial sustainability.

We note that the development literature originated the term "sustainability" with respect to natural resources. The UN Environmental Programme (UNEP), for instance, defines sustainable development as "improvement in the quality of human life while living within the carrying capacity of supporting ecosystems" (Forsyth, 2005, p. 666). However, Forsyth asserts that, "there is no unique or universal definition of sustainable development" (p. 666). Thus, we follow the Asian Development Bank's (2006) definition of *financial sustainability*:

> The assessment that a project will have sufficient funds to meet all its resource and financing obligations, whether these funds come from user charges or budget sources; *will provide sufficient incentive to maintain the participation of all project participants* (emphasis added); and will be able to respond to adverse changes in financial conditions.

The italicized phrase above is critical to financially sustainable development. For ICT to fit within the carrying capacity of UB, the funding agency (the National Assembly of Parliament, where Ministry of Education grants are approved) must perceive an incentive to participate, i.e., to continue and increase funding. That perception in the Assembly is directly linked to evidence that investment in ICT brings a rate of return exceeding cost.

Such evidence, however, is scant. No specific study has quantified costs versus benefits of ICTs at UB, although qualitative (sometimes anecdotal) evidence points to the benefits. Evidence of this sort appears in the discussion in subsection 3.4, particularly of many aspects of Levels 1 and 3. Lacking hard data and competing in the National Assembly with political pressures from other national priorities like Botswana's HIV/AIDS health crisis, UB has not yet been successful in establishing the incentive to maintain participation or in achieving financial sustainability for ICT.

Currently the annual education grant to UB consists of budget items that are relatively "given" or assured and those like ICT that are less so. Lecturers and students daily see the need for added spending in the area of infrastructure, repair, replacement, and user support. ICTs are not within the carrying capacity of UB. Each year UB must make extraordinary efforts for operating funds (not to mention for growth in demand) as well as for funding for repairs and replacements. Until the government perceives an incentive to underwrite ICTs and meets the demands that the growth of ICTs places on the university's resources similarly to funding, the staff salary base (if not salary increases) and normal overhead such as basic maintenance of the university's physical facilities—financial sustainability remains unattained.

Fonseca (2001) describes ICT without financial sustainability as "purely rhetorical" (p. 404). That overstates the case at UB, where many students and staff enjoy many advantages of ICTs in education, and yet, in the end, financial sustainability is a fundamental requirement for full functionality (Benner, 2004, p. 90; Fonseca, 2001, p. 399; Welsh & Butorin, 1990, p. 312). It belongs in the S-H model as a major factor affecting the likelihood of ICT success in aiding development. To incorporate this conceptually, we propose Level 4 ("Financial Sustainability"). Like the other three major levels of the S-H model, such a level would comprise a series of aspects:

- **Zero funding:** ICTs have not yet arrived;
- **Startup funding:** ICTs appear, in pilot programs, although widespread community use is at best sporadic;
- **Full-scale funding (external, temporary):** ICT use becomes established and spreads to the full user community. Full functionality varies and continued operation cannot be counted on because funding is vulnerable; and
- **Full-scale funding (sustainable):** ICTs are available and consistently reliable for the full user community without annual threat of diminished funding.

The third aspect described above, *full-scale funding (external, temporary)*, most nearly describes the reality of ICT at UB, rather than the more desirable fourth aspect. UB publicly recognizes that financial sustainability is a needed priority. Its recent strategic plan *Shaping Our Future* (University of Botswana, 2005, p. 8) pledges "to implement a financial management strategy which includes programs for *self-resourcing* (emphasis added) ... in order to secure and efficiently manage financial resources necessary for the university to fulfill its aspirations, objectives, and activities." The future will reveal the extent to which "self-resourcing" leads UB to alternatives to conventional government funding.

5. CONCLUSION AND REINTERPRETATION OF THE MODEL

Together, the deletions and additions to the S-H model growing out of the case study reflect that change accompanying ICT is not so much gradual as it is "graduated." Though the timeframe may not be long in an absolute sense, there are steps—more evolutionary than revolutionary—by which ICT becomes established. The addition of time (subsection 4.3) and financial sustainability (subsection 4.4) to the model underscores the need for building reliable ongoing support for ICTs, if they are to influence development robustly. These equip the S-H model to distinguish between development started and development established, a long-term matter.

A graduated process, encompassed by the revised S-H model, resembles Tuomi's "bubble and crash" pattern characteristic of "techno-economic paradigms" (2004). Difficulties, interruptions, and midcourse corrections happen, and we should not take them solely as negatives. Rather, Tuomi asserts, "The bubbles and crashes can be interpreted to mean that [ICT is] starting to become important ... It is therefore quite probable that the social and economic transitions that move us towards the knowledge society are mainly ahead of us."

We see more concretely from the case study how well Heeks' paradigm of deeply and shallowly inscribed organizational change (subsection 2.1) suits the S-H model. Both deeply and shallowly inscribed applications of ICT occur at UB and have markedly altered the University's core development activities of instruction and research. Online searching in the Library catalog, word processing, and e-mailing are arguably shallow inscription examples. The same goes for greater efficiencies in the financial and administrative offices.

More profound, however, are the new teaching styles being practiced. Lecturers now engage their students in project-based learning with hands-on work utilizing the Internet as well as application and classroom management software. Such change constitutes deep inscription, which, even factoring in delay and setback, is "transforming educational culture" at this university (Fonseca, 2001, p. 410).

In the development literature, "human development" is sometimes defined by what it is not: the advancement of "not only economic, social, ... and basic material needs," and something broader than "an increase in people's skills" (Forsyth, 2005, pp. 323–324). More affirmatively, it can mean "the empowerment of people to satisfy their own desires and those of others" in contrast to material gains alone (Welsh & Butorin, 1990, p. 312) and "the promotion and advance of a broad definition of well-being" (Forsyth, 2005, p. 323).

The bumpy arrival and troubled ongoing performance of ICTs at UB (and in the small business sector of Botswana) represent a blow to a human sense of well-being and even of empowerment. The arrival of new equipment tends to raise user expectations; its underperformance in turn may lower them.

The terms of the S-H model operationalize such human development factors. For example, when students and staff experience uneven ICT functionality, they benefit only partially from that aspect of ICT as *tool* and little or not at all from its *proxy* aspect or as *part of an ensemble.* That could, unhappily, instill a reluctance to embrace future innovation (Morales-Gomez, 1998).

6. FURTHER RESEARCH

Literature about the case study method expresses "disagreement over whether single case studies can make only limited contributions to theory building or whether single case studies have indeed reshaped entire research programs" (Smelser & Baltes, 2001, Vol. 3, p. 1517). We, like Sein and Harindranath, leave the newly revised S-H model as a work in progress and invite further refinement. One avenue for expanding the case study would be examining ICT in other sectors in Botswana: business, government, or health-care for example. A second avenue is testing the model in cases involving other developing nations and a third is cross-case studies. Beyond that, comparative testing of the original and revised models will continue the course of model development, all with the aim of better and wiser planning, installation, utilization, and evaluation of ICTs.

In the long run, will this case study's impact on the S-H model be long lasting? We may have optimized the variables for the present, but both technology and society are evolving and therefore so must any applicable theoretical model. For now an optimized S-H model may awaken planners of ICT to think more deeply about the 3rd-order, ensemble effects of their innovations, the adequacy of support infrastructure to meet growing demand, and the priority of financial sustainability.

REFERENCES

Andrew, T. N., & Petkov, D. (2003). The need for a systems thinking approach to the planning of a rural telecommunications infrastructure. Telecommunications Policy, 27(1), 75–93.

Asian Development Bank. (2006). Guidelines for the economic analysis of projects. Retrieved May 17, 2006, from http://www.adb.org/Documents/Guidelines/Eco_Analysis/glossary.asp

Balancing Act. (2005). Botswana liberalisation special—Re-arranging the deckchairs or the real thing? Balancing Act News Update, No. 243. Retrieved March 30, 2005, from http://www.balancingact-africa.com/news/back/balancing-act_243.html

Belotti, R., Decurtins, C., Grossniklaus, M., Norrie, M., & Palinginis, A. (2004). Modelling context for information environments. In L. Baresi (Ed.), Ubiquitous mobile information and collaboration systems, 2nd CAiSE Workshop, UMICS 2004, Riga, Latvia, June 7–8, 2004, revised selected papers (pp. 43–56). Berlin, New York: Springer.

Benner, C. (2004, September-October). De-hyping IT. Foreign Policy, No. 144, 90–91.

Botswana Press Agency. (2004). Botswana Internet usage a meagre 5 per cent. Daily News Online (Republic of Botswana). November 30, 2004. Retrieved March 30, 2005, from http:www.gov.bw/cgi-bin/news.cgi?d=20041130

Carden, F. (2004). Issues in assessing the policy influence of research. International Social Science Journal, 56(179), 135–151.

De', R. (2005). E-government systems in developing countries: stakeholders and conflict. In M. A. Wimmer (Ed.), Electronic government (EGOV), Proceedings of the 4th International Conference, Copenhagen, Denmark, August 22–26, 2005 (pp. 26–37). Berlin, New York: Springer.

Department of Information Technology, Botswana. (2005, February). National ICT policy will cost about a billion pula in five years: The roadmap is in place. Botswana Digital News, No. 3, 1–3.

eMarketer. (2001). The eGlobal report. New York: eMarketer.

Fonseca, C. (2001, September). Fallacies and objectives regarding the uses of new technologies in education. Prospects 31(3), 399–413.

Ford, N. (2005, April). The jewel of Africa. African Business, No. 308, 50–51.

Forsyth, T. (2005). Encyclopedia of international development. London/New York: Routledge.

Frieden, R. (2005). Lessons from broadband development in Canada, Japan, Korea, and the United States. Telecommunications Policy, 29, 595–613.

Gaolathe, B. (2005, February 7). Budget speech delivered by the Minister of Finance and Development Planning to the National Assembly of Botswana. Retrieved March 30, 2005, from http://www.gov.bw/speeches/budget.pdf

Gerhan, D. R., & Mutula, S. M. (2005). Bandwidth bottlenecks at the University of Botswana: Complications for library, campus, and national development. Library Hi Tech, 23(1), 102–117.

Giannini-Gachago, D. & Molelu, G. B. (2005). Facts, figures, and experiences with the introduction of e-learning in a higher education institution in developing environments—The case of the University of Botswana. Lonaka Bulletin (Centre for Academic Development, University of Botswana), 30–35.

Heeks, R. (2002, March). Information systems and developing countries: Failure, success, and local improvisations. The Information Society, 18(2), 101–112.

Ifinedo, P. (2005). Measuring Africa's e-readiness in the global networked economy: A nine-country data analysis. International Journal of Education and Development Using ICT, 1(1). Retrieved April 19, 2005, from http://ijedict.dec.uwi.edu/viewarticle.php?id=12&layout=html

Infoplease. (2005). Area and population of countries. Information Please Almanac. Retrieved June 1, 2005, from http:www.infoplease.com

International Development Research Centre. (2006). Information and communication technologies for development. Retrieved February 16, 2006, from http://www.idrc.ca/en/ev-43441–201–1-DO_TOPIC.html

International Telecommunication Union. (2003). World telecommunication development report: Access indicators for the information society. Geneva, Switzerland: International Telecommunication Union.

International Telecommunication Union. (2004). African telecommunication indicators. Geneva Switzerland: International Telecommunication Union.
ITEC Group. (2005). BTC rolls out high-speed broadband Internet links. Botswana Digital News, No. 4, 1.
Moore, F. (2000). The paradox: As storage and bandwidth all drop to zero dollars, who can make a buck? Computer Technology Review, 20(7), 1, 39–40.
Morales-Gomez, D., & Melesse, M. (1998). Utilising information and communications technologies for development: The social dimensions. Information Technology for Development, 8(1), 3–13.

Mutula, S. M. (2005). An assessment of e-readiness of small and medium-sized enterprises (SMEs) in the ICT sector in Botswana with respect to information access. Unpublished doctoral dissertation, University of Johannesburg, South Africa.
Mutula, S. M., Kalusopa, T., Moahi, K., & Wamukoya, J. (2006). Design and implementation of an online information literacy module: experience of the Department of Library and Information Studies, University of Botswana. Online Information Review, 30(2), 168–187.
Mutula, S. M., Komanyane, K., & Grand, B. (2005). Cell phone use by students at the University of Botswana: A comparative study of Library and Information Studies and other departments. African Journal of Library, Archives and Information Science, 15(1), 81–85.
News Portal. (2006). eLearning Africa; 1st international conference on ICT for development, education and training, UNCC, Addis Ababa, Ethiopia, May 24–26, 2006. Retrieved June 2, 2006, from http://www.elearning-africa.com/newsportal/english/news13.php
Sein, M. K., & Harindranath, G. (2004, January-March). Conceptualizing the ICT artifact: Toward understanding the role of ICT in national development. The Information Society 20(1), 15–24.
Simpson, L., Lennie, J., Daws, L., & Previte, J. (1998, October 26–27). Taking social structure into account: Lessons from a collaborative Australian project involving rural women and communications technologies. Paper presented at the Partnerships and Participation in Telecommunications for Rural Development Conference, Guelph, Ontario, Canada. Retrieved February 8, 2005, from http://www.devmedia.org/documents/Women and Tech Australia.htm
Smelser, N., & Baltes, P. (2001). International encyclopedia of the social and behavioral sciences. Amsterdam: Elsevier.
Stoecker, R. (1991, February). Evaluating and rethinking the case study. Sociological Review 39(1), 88–112.
Theodorson, G., & Theodorson, A. (1969). A modern dictionary of sociology. New York: Crowell.
Tuomi, I. (2004, July). Economic productivity in the knowledge society: A critical review of productivity theory and the impacts of ICT. First Monday, 9(7), Retrieved January 31, 2005, from http://firstmonday.org/issues/issue9_7/tuomi/index.html
University of Botswana. (2005). Shaping our future: Strategic plan. Retrieved May 22, 2006, from http://www.ub.bw/about/documents/shaping_our_future.pdf
Waswa, M. (2006). An assessment of the use of ICTs by academic staff in the Faculty of Social Science. Master's thesis, Department of Library and Information Studies, University of Botswana.
Welsh, B. W. W., & Butorin, P. (1990). Dictionary of development: Third world economy, environment, society. New York/London: Garland.
World Bank. (2004). ICT at a glance. In World Bank. Data by country. Retrieved June 16, 2005, from http://www.worldbank.org/data/countrydata/countrydata.html
World Bank. (2005). World development indicators. Washington, D.C.: The World Bank.
World Bank. (2006). WDI online. Retrieved March 13, 2006, from http://devdata.worldbank.org/dataonline/

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