

**Teledensity Growth Constraints and Strategies for Africa's LDCs:
'Viagra' Prescriptions or Sustainable Development Strategy? — African
Telecommunications Stakeholders Speak**

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ABSTRACT

Over-dependence of Africa's Least Developed Countries (LDCs) on the West has been reflected in various socio-economic dimensions. Such dependence has also been reflected in the telecommunications industry of Africa's LDCs in their quest to improve their historically low teledensity (number of main telephone lines per one hundred inhabitants).

African LDCs lag other regions of the world in utilizing information and telecommunications technologies. The resulting digital divide has hitherto left African LDCs far behind other regions of the world in various aspects of economic development. Many technology-oriented constraints account for the low levels of teledensity in Africa.

The fact that the trend should not be allowed to worsen has led to calls for a debate on what strategies can be adopted to turn things around. Possible options include the following: (a) self-sufficiency approach by each country, (b) African Regional/Foreign Alliance approach to solve the regional technology-oriented constraints to teledensity, and (c) the 'viagra' approach of total and perpetual dependence on the West to come in and apply a band-aid fix to the problem, and leave behind an infrastructure with little or no local expertise to manage it. In this paper, the term 'viagra' is used to imply a quick prescription in a guise of a "solution".

Using Friedman's test, factor analysis, and multivariate analysis of variance (MANOVA) statistical procedures, this study examines the perspectives or beliefs of telecommunications stakeholders of Africa's LDCs on strategies for solving the technology-oriented constraints that have been documented in the literature. The findings suggest that Africa's LDCs should adopt a self-sufficiency approach and also create regional alliances for sustainable development of telecommunications infrastructure to spur the much needed teledensity growth in the region.

INTRODUCTION

One of the major prerequisites for sustainable economic growth for a modern society is the development of sound infrastructure in the telecommunications sector. The establishment of a modern, reliable, efficient, and capacity-flexible telecommunications infrastructure contributes considerably to the promotion of a variety of activities of economic expansion (World Bank Telecommunications Sector Reports, 1991). Some researchers have associated the level of a country's telecommunications infrastructure to its teledensity level (Gille, 1986; Saunders et al., 1994).

There is a great disparity between the level of teledensity of Lesser (or Least) Developed Countries (LDCs) and that of developed countries. The average teledensity for LDCs is a mere 0.29, whereas it is 11.57 for the world, 31.95 for Europe, 68.31 for Sweden, and 60.17 for the United States. The total number of telephone main lines in the 48 LDCs is about 1.5 million, which is about 1% of the total number of lines in the United States (Rorissa, 1999). Least Developed Countries (LDCs) are defined as low-income countries suffering from long-term constraints to growth. In particular, these growth constraints include low levels of human resource development and severe structural, economic, social, and political weaknesses (Austin, 1990). Currently, there are 48 LDCs as defined by the United Nations. Of the 48 LDCs, 30 are in Africa, which constitutes more than 60 % of the world's LDCs. Table 1 shows the criteria for inclusion in the LDC category.

The African continent, which is three-and-a-half times the size of the United States of America consists of 54 countries. It is within this complex geographical framework that some African development organizations and telecommunications stakeholders such as the Organization of African Unity (OAU) and the Economic Commission for Africa (ECA)

Table 1: Criteria for Inclusion to the list of LDCs.

Old criteria for inclusion

The original set of criteria for constructing a list of countries classified as LDCs was adopted in 1971:

1. Per capita income per year: less than US \$200. This figure, revised periodically, stood at US \$600 in 1998.
2. Share of industrial production in the Gross National Product (GNP): under 10 percent.
3. Adult literacy rate: less than 20 percent.

New criteria for inclusion

New criteria for determining LDCs was established in 1994:

1. Population: less than 75 million.
2. Per capita Gross Domestic Product (GDP): less than US \$700 (averages 1990-92).
3. Augmented physical quality of life index (APQLI): less than 47.²
4. Economic diversification index (EDI): less than 26.³

² APQLI comprises four indicators: life expectancy at birth, per capita calorie supply, school enrolment ratio, and adult literacy rate.

³ EDI comprises the share of manufacturing in GDP, the share of employment in industry, per capita electricity consumption, and the export concentration ratio.

recognized the need for ventures to improve Africa's network connectivity. To achieve this goal, several projects have been initiated. The most ambitious of these, in terms of geographic scope, was the Pan-African Telecommunications Network (PANAFTEL), which laid a foundation for an African continent-wide telecommunications network (International Telecommunications Union Publication, 1987).

In 1987, the president of Ivory Coast, President Felix Houphouet Boigny warned his countrymen that since "Africa missed the industrial revolution, we can't afford to stand aside and let the communication revolution go by too" (International Telecommunications Union Publication, 1987, p. 7). This statement supports the fact that telecommunications development has been understood for some time as a vital need for the continent. Despite the various initiatives, the continent has, for the most part continued to rely on the West, and its system has, to a large extent, remained decrepit and incapable of supporting meaningful growth in teledensity.

Research has shown that there is a high correlation between telecommunications infrastructure (represented by teledensity) and the level of economic power represented by the national per capita Gross Domestic Product (Saunders et al., 1994). Other studies have shown a relationship between the telecommunications infrastructure and the national economy (Hardy, 1980), and that growth in teledensity is a catalyst of resource mobilization and economic development (Jussawalla, 1988).

BACKGROUND AND PROBLEM STATEMENT

Modern telecommunications technologies and facilities were introduced to African countries during the colonial era (Hachten, 1971; Bofo, 1991), beginning with radio and telegraph systems. These telecommunications facilities catered to the information, communication, and entertainment needs of expatriate colonial officials, and later, the small number of local elite. Most of these local elite consisted of high level civil servants and business people.

The political leaders and administrators who emerged in post-independence Africa were mainly what Bofo calls "nationalist-politician-journalists" who led their people in the fight for independence. Once the nationalist leaders assumed the reins of government, they tended to move into their new roles as political leaders and policy-makers, but without a clear vision of how to improve the telecommunications infrastructures of their countries (Bofo, 1991). The following commentary by Bofo sheds some light as to the state of affairs in post-colonial Africa (Bofo, 1991, p. 23):

Prominent independence leaders such as Kwame Nkrumah of Ghana, Nnamdi Azikiwe of Nigeria, Jomo Kenyatta of Kenya, Felix Houphouet Boigny of Ivory Coast, Leopold Senghor of Senegal, and others were leading journalists who established or edited newspapers and other publications used to express nationalist sentiments, criticize colonial policies, and advocate political independence. Upon the attainment of independence, these nationalist leaders became political leaders and policy makers. They moved into government with their newspapers and exercised excessive control over the media in the generally professed interest of nation building, political unity, and national consciousness. The new political leaders and administrators made very little genuine modification in the structure, utilization, and orientation of

telecommunications infrastructure to make them effective and meaningful instruments for development.

Suffice it to say, LDCs in general, and African LDCs in particular, continue to lag the rest of the world into the 21st century in various aspects of economic development. In fact, the gap continues to widen at an accelerating pace. For example, it is estimated that the city of New York has more telephone lines than the whole continent of Africa. Furthermore, worldwide growth in Internet diffusion and electronic commerce has left African LDCs wavering behind other parts of the globe. Levine relates this problem to the low levels of teledensity in LDCs (Levine, 1999). In a Panos Institute study, poorly developed telecommunications networks and low levels of teledensity represented a major constraint to Internet development in African LDCs (The Panos Institute, 1998).

Researchers have identified the use of antiquated and difficult to maintain equipments which are commonplace in LDCs as major constraints to teledensity growth in LDCs. The exorbitant cost of maintaining the outdated equipment and infrastructure, coupled with shortage of well-trained personnel result in poor quality of service and loss of revenues (Mbarika et al., 2000b). In some LDC countries, it is not unusual for a malfunctioning telephone equipment to take months before a maintenance team arrives to attempt a rescue. The International Development Research Center (IDRC) pointed to the over-dependence of most Sub-Saharan African countries on foreign technicians and consultants in the maintenance of telecommunications infrastructures and the development and enactment of key telecommunications policy guidelines respectively (IDRC, 1990). The IDRC notes this has contributed to the formulation of policies that do not adequately address the real needs of these countries. Thus, the need for further development of the capabilities of local technical experts in

the field telecommunications is of prime importance in the quest to creating sustainable teledensity growth in Africa's LDCs.

The Maitland Commission has identified several problems related to continued reliance on outdated infrastructure built by foreign companies:

- Imported equipments are not always suited to the environments and needs of LDCs.
- Most of the foreign manufacturers have stopped producing parts for the old systems that are still widely used in LDCs.
- Mixed-and-matched parts and equipments installed over the years lead to difficulties in training, compatibility and maintenance.

Against this background, African telecommunications stakeholders have engaged in the Herculean task of developing appropriate architecture that would ensure that the telecommunications industry plays the expected catalytic role in national development. This task has generated debates as to the approaches that would best ensure that the telecommunications sector positively impacts the development process needed.

This paper focuses on strategies to address technology-oriented constraints to teledensity growth in Africa's LDCs. We commence by presenting formal sections on objectives (which also outlines the different groups of telecommunications stakeholders), research questions, and methodology, we discuss the stakeholders' views or perspectives on the technology-oriented constraints that have been identified in the literature. This is followed by data collection, analysis, and discussion of results. We conclude with a section on implication and future research opportunities related to this study.

RESEARCH OBJECTIVES

This study examines the technology-oriented constraints to teledensity growth in LDCs in general, and African LDCs in particular. After the technology-oriented constraints that African LDCs face are identified, appropriate strategies for mitigating the constraints are presented. Literature shows that the strategies have been utilized to enhance teledensity growth in developed countries. Techniques for matching specific strategies to address the identified constraints are drawn from the literature.

Part of the objective is to show that there are two main groups telecommunications stakeholders: government stakeholders (GSH) and non-government stakeholders (NGSH). Within each group we have sub-groups. This classification is based on a United Nations study titled “The Process of Developing National Information and Communications Infrastructure (NICI) in Africa”, which classified African telecommunications stakeholders as (UN, 2000):

(a) Governmental Stakeholders (GSH), which are made up of

- (1) Government entities,
- (2) Parastatals (these are “for-profit” auxiliary government-controlled pseudo corporations),
and
- (3) Telecommunications Operators (government controlled)

(b) Non-Governmental Stakeholders (NGSH), which consist of

- (1) Telecommunications Operators (non-government controlled),
- (2) Academia, Research Centers and IT experts, and
- (3) International/Regional private organizations

The African LDCs telecommunications stakeholders have suggested different strategies to solve the low teledensity problem. In order to understand the differences in the stakeholders’

perspectives, one could look at the issue of ownership of telecommunications infrastructure and the regulation of the telecommunications industry. These stakeholders have adopted a vast range of approaches or models toward regulatory activities (Bruce, 1989; Foreman-Peck and Muller, 1988). Part of the objective in this study is to see if the stakeholder groups perceive the effectiveness of the various strategies differently. Furthermore, we would like to know if there are significant interactions of perspectives across stakeholder affiliations (not just across groups).

As the study revealed, the stakeholders do not agree on what service should be regulated and what should not. For instance, government stakeholders and parastatals are advocates for the telecommunications operation to be government-owned-and-controlled monopoly “for reasons of national security”. Most non-government stakeholders believe that the telecommunications industry should be privatized, and the regulations liberalized “to allow for free entry, thereby promoting competition, which would benefit the economy” (Mbarika et al., 2000a).

Academicians (as a sub-group of stakeholders) have generally pointed to “the fundamental importance of having universal services in order to close the gap between teledensity of urban areas and teledensity of rural areas, which will provide rural areas with some communications services” (Saunders, 1982).

The non-government stakeholders advocate the United States model where private entities largely own the telephone networks, and the government acts only as the regulator. In some LDCs, some stakeholders even resist the basic idea of liberalization of regulations that might spur competition. Indeed, there is a plethora of stakeholder views or perspectives on strategies. We seek to explain these in this study.

RESEARCH QUESTIONS

As previously mentioned, the motivation for this study is to investigate African telecommunications stakeholders' perspectives of strategies and how the strategies could be used to address the constraints to teledensity growth in African LDCs. To do this, three main research questions were developed.

Research Question 1:

What are the LDCs telecommunications stakeholders' (government and non-government) perspectives on the major technology-oriented strategies for overcoming technology-oriented constraints documented in the literature? How can we make sense of these perspectives?

Research Question 2

How do African government telecommunications stakeholders (GSH) perceive technology-oriented strategies for addressing the constraints to teledensity growth?

Research Question 3

How do African non-governmental telecommunications stakeholders (NGSH) perceive technology-oriented strategies for overcoming the constraints to teledensity growth? Also, are there any significant overlaps in perceptions by affiliation (whether as a regulator, operator, or research agency)? Research questions 2 and 3 seek to examine possible differences and interactions of perceptions among stakeholder sub-groups (government; parastatals; government controlled telecommunications operators; non-government controlled telecommunications operators; academia, research centers and IT experts; and international/regional private organizations).

METHODOLOGY

A survey was developed using the existing strategies documented in the literature. Survey participants were solicited to analyze the existing strategies, propose new ones and to modify or add new insights to the strategies.

Participants were chosen from African and other LDC countries around the world. Although there were responses from stakeholders from non-African LDCs, data analysis was conducted on the African LDC responses only, since that is the primary focus in this study. The other data would be used in future research.

To examine the first question, the survey participants were asked to assess, using a Likert scale from 1 (strongly disagree) to 7 (strongly agree), their perception of the criticality of each strategy for promoting teledensity growth.

A pilot test of the questionnaire was conducted by randomly selecting participants from the “Afrik-IT” listserv⁴. The pilot test involved 15 participants. The pilot test was used to fine-tune the questionnaire used in the main study.

Both the pilot and full studies were administered using both traditional (paper-based) and web-based methods. As documented in the literature, both of these methods have their inherent advantages and limitations (Alreck and Settle 1996; MacElroy and Geissler 1994; Matz, 1999; Medlin et al., 1999; Zhang, 2000).

The traditional (paper) version of the survey was sent to the respondents either by postal mail or as an e-mail attachment. Here, the authors kept in mind the potential drawback of this approach, especially considering the increasing threat and scare from computer viruses attached to e-mail messages. To minimize any chance of our survey e-mail messages being ignored or

⁴ Afrik-IT is an African network of IT experts and professionals.

deleted on arrival, personalized e-mails messages were sent to the respondents using their professional titles and clearly explaining the purpose and importance of the research through the e-mail method. Respondents using the traditional (paper) questionnaires were provided a fax number to which the survey could be returned.

After an adequate number of responses were returned, a Factor Analysis was conducted to verify the groups and sub-groups of strategies (Babbie, 1989, pp. 450-453). A rank order of each category of strategies was also evaluated using Friedman's Test (Kerlinger, 1986, p. 271). This is a more direct evaluation of the investigator's research question or hypothesis that involves the association of the ranks. The Friedman's Test therefore tests the null hypothesis that k related variables or factors come from the same population. For each case, the k variables are ranked from 1 to k, and the test statistic is based on these ranks. Each case is a judge or rater, and each variable is an item or person being judged. In this case, each stakeholder was a rater of each factor (strategy) and its associated sub-factor. The null hypothesis states that there is no difference in mean ranks (the sum of ranks divided by the number of cases) of the stakeholders' perceptions of strategy effectiveness, while the alternative hypothesis states that a difference exists in the mean ranks of the stakeholders' perceptions.

As will be presented in greater detail in this study, there are three main strategies or factors, which were broken down into a total of eight sub-strategies. A Multivariate Analysis of Variance (MANOVA) was computed for each of the sub-factors or sub-strategies in the study.

The number of strategies and sub-strategies in the study are kept the same as the ones that have already been documented in literature. This was to avoid introducing too many factors for which we do not have enough supporting knowledge at this point; future work in this area will be built on this.

DATA COLLECTION AND ANALYSIS

There were two-hundred and twelve questionnaires sent to individuals, and a 33.5% response rate was established with the 71 responses that were returned. Although, as pointed out earlier, the focus in this research is Africa’s LDCs, questionnaires were sent to stakeholders in other parts of the world. It should be noted here that some stakeholders are affiliated to development organizations that are not necessarily headquartered in Africa. Many development organizations are headquartered in Europe and North America. The data from the respondents are displayed in Figure1.

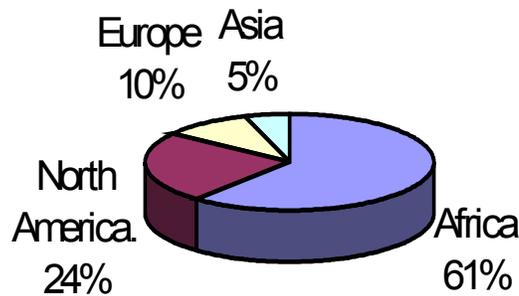


Figure1. Distribution of Respondents in the Survey by Region

Distributions of the respondents across Africa’s LDC stakeholders by group or affiliation are summarized in Table 2. As indicated in the table, there were 29 governmental and 42 non-governmental participants from whom responses were received from Africa’s LDCs. The breakdown within each group or sector is also shown in the table.

Table 2: Breakdown of Africa’s LDC Respondents

Stakeholder Affiliation	Stakeholder Group	
	Gov’t S. H.	Non-Gov’t S. H.

Telecommunications Operator	6 (21%)	8 (19%)
Telecommunications Regulator	20 (69%)	4 (10%)
Academia, Research Centers, Development Agency	3 (10%)	30 (71%)
Total	29 (100%)	42 (100%)

Note: Percentages (in parenthesis) are rounded to whole numbers.

Reliability

Reliability is an important consideration in data collection and analysis. Reliability is an assessment of the degree of consistency between multiple measurements of a variable. The type of diagnostic measure used in this study is the reliability coefficient that assesses the consistency of the scale using Cronbach's alpha. In research of this type, this measure has a generally accepted lower limit of 0.60 (Nunnally, 1979; Peter, 1979; Robinson et al., 1973; Robinson et al., 1991). Cronbach's alphas were computed for each of the three main factors (i.e., main strategies) cited in the in the abstract and listed in Table 3.

Table 3: Factors and their corresponding Cronbach's Alphas for Technological-Oriented Strategies

Main Factor or Strategy	Cronbach's Alpha	Number of sub-strategies
Self-sufficiency	0.62	3
African Regional/Foreign Alliance	0.67	2
Total Foreign Dependency	0.81	3

The overall Cronbach's alpha based on responses from Africa's LDC stakeholders was calculated to be 0.89. Cronbach's alphas for the three major factors are as summarized in Table 3. In each case, the alpha obtained reflects acceptable levels of reliabilities of the pertinent questions in the survey. The values of alphas obtained gave a reasonable assurance that the sub-factors (or sub-strategies) associated to the main factors (or main strategies) coalesced adequately to measure the factors. Scaled value for each main factor was computed by averaging the responses across the sub-factors that best represent the main factor (or strategy). As mentioned earlier, each of the three main factors or strategies is broken into sub-factors (or sub-strategies) as shown in Table 4.

Table 4: Main Factors (Strategies) and Sub-factors of Teledensity Growth

Main Factor	Sub-factor Item Number	Sub-factor Description
Self-Sufficiency	Item 1	African LDCs should review the possibilities for local or regional manufacture of telecommunications equipment.
	Item 2	Operators and manufacturers should enhance the training opportunities they offer to telecommunications staff of African LDCs.
	Item 3	African LDCs should be trained to carry out monthly routine maintenance of already existing equipment.
African Regional/ Foreign Alliance	Item 4	African LDCs, with assistance of funding organizations, should set up long-term contracts to buy new knowledge from developed countries (i.e. advocate for joint ventures).
	Item 5	Development organizations should conduct seminars to improve the qualifications of experts of African LDCs.
Total Foreign Dependency	Item 6	African LDCs should solicit help from developed countries to build and install their telecommunications equipment.
	Item 7	When purchasing equipment from foreign countries, African LDCs should ensure that the contract includes commitments on the supply of spare parts and post-installation review.
	Item 8	African LDCs should hire foreign experts to perform routine maintenance of already existing equipment.

Factor Analysis

A factor analysis approach was conducted to confirm the reasonableness of grouping the eight sub-strategies in the manner depicted in Table 4. The eigenvalues and percentage of variance summarized in Table 5 indicate that it may be possible to factor the constructs to a smaller set of factors that could explain the phenomenon under study (Babbie, 1989). Using the cumulative percentage of variance criterion, and noting the fact that the first three sub-factors of technology-oriented strategies accounted for more than 60% of the variance, it appears that the last five sub-factors were not perceived to be as important as the first three.

Table 5: Eigenvalues and Percentage of Variance for the Extraction of Component Factors for Technology-oriented Strategies.

Sub-Factor	Eigenvalues	% of Variance	Cumulative %
1	2.678	33.474	33.474
2	1.892	24.901	58.375
3	1.060	12.000	70.375
4	.677	8.460	78.835
5	.593	7.409	86.244
6	.468	5.845	92.089
7	.393	4.918	97.007
8	.239	2.993	100.000

As reported in Table 5, the eigenvalues for the first three sub-factors were greater than or equal to 1. This led the researchers to conclude that the three sub-factors in each case could be used to summarize the groups of strategies used in this study (Green et al., 1997). An orthogonal VARIMAX factor rotation was used to confirm which items loaded on the three sub-factors. The rotation converged in three iterations, and the results are shown in Table 6.

Table 6: Rotated Factor Matrix for Technology-oriented Strategies.

	Factor1	Factor2	Factor3
<u>Sub-Factor</u>	<u>Loading</u>	<u>Loading</u>	<u>Loading</u>
1	.534	-.002	.393
2	.654	.009	.154
3	.541	.439	.232
4	.108	.860	-.498
5	.239	.542	.001
6	-.515	.165	.623
7	-.388	.121	.699
8	-.153	.321	.433

Research Questions Re-visited

In this section, we re-visit the three main questions raised earlier. We first discuss the results of the ranking of the sub-factors or sub-strategies identified in the study. This yields some insight on the first question. The second and third questions could be answered by analyzing the stakeholder sectors (government versus non-government) in terms of the stakeholders’ perception of importance of the various strategies (factors) and sub-strategies (sub-factors) identified.

As summarized in Table 7, mean value and standard deviation were computed for each main factor. Collectively, the three main factors or strategies (i.e., self-sufficiency, African regional/foreign alliance, and total foreign dependency) had means of 5.82, 5.52, and 4.78, respectively. These rank order of the means results revealed that the “self-sufficiency” and “African Regional/Foreign Alliance” strategies were ranked highest, with no significant difference, whereas the “Total Foreign Dependency” strategy was ranked significantly the lowest.

Table 7: Rank Order of Means for Technology-oriented Strategies

Rank	Mean Rank	Mean	Std. Deviation	Factor or Strategy
1	2.24	5.82	1.01	Self-Sufficiency
2	2.24	5.52	1.61	African Regional/Foreign Alliance
3	1.52	4.78	1.76	Total Foreign Dependency

$\chi^2 = 31.13$; d.f. = 2; Significance = .000⁺⁺

As previously mentioned, similarities and differences (by affiliation) of stakeholders' perceptions of effectiveness of the various strategies are the issues captured in this study. A 3 x 2 factorial multivariate analysis of variance (MANOVA) was carried out to investigate possible differences amongst stakeholders' affiliation and group, possible interaction between such, and the significance levels of the results (Neter, et al., 1996). Table 8 presents the MANOVA results.

Table 8: MANOVA results for Technology-oriented Main Strategies

Effect	F-value	P-value
Affiliation ⁵	1.562	.171
Group (GSH vs. NGS)	5.783	.003**
Affiliation * Group	.373	.894

*P < 0.05; **p < 0.01; ***p < 0.001

Note: The F and P Values used are based on Pillai's test.

⁵ The three levels (categories) of Affiliation were: Telecommunications Operators, Telecommunications Regulators; and Academia, Research Centers, IT experts and International/Regional organizations.

From the results obtained, we observe that there is a significant difference in stakeholders' perceptions on Technology-oriented strategies based on group membership (government versus non-government). However, there was no significant evidence of any affiliation main effect or of any interaction effect (since affiliation * group has a P-value of 0.894). As earlier indicated in Table 2, a stakeholder in the study could be affiliated in one of three ways. These are telecommunications operator, telecommunications regulator, or academia/research/development agency. The result of the post-hoc ANOVA for the "Effect of Group", shown in Table 9 supports this observation.

Table 9: ANOVA results for the Effect of Group

Factor	Effect	df	Sum of Squares	Mean Square	F-value
Self-Sufficiency	Affiliation	2	.856	.428	.529
	Group	1	5.565	10.163	12.560**
	Interaction	2	.223	.111	.138
African Regional/Foreign Alliance	Affiliation	2	4.474	2.237	.883
	Group	1	.367	.367	.145
	Interaction	2	2.277	1.138	.450
Total Foreign Dependency	Affiliation	2	15.761	7.881	2.786
	Group	1	10.163	5.565	1.968
	Interaction	2	3.097	1.548	.547

*P < 0.05; **p < 0.01; ***p < 0.001

These ANOVA results show the strongly significant differences in perceptions of governmental versus non-governmental stakeholders' perceptions of effectiveness of strategies. The governmental stakeholders were significantly stronger in their perception of the effectiveness of the "self-sufficiency" strategy than the non-governmental stakeholders; the means were 6.67 and 5.28, respectively.

DISCUSSION OF RESULTS

As shown earlier, the three main factors (Self-Sufficiency, African Regional/Foreign Alliance, and Total Foreign Dependency) had means of 5.82, 5.52, and 4.78, respectively. The results of the rank order of the means revealed that the “Self-Sufficiency” and “African Regional/Foreign Alliance” factors were ranked highest, with no significant difference between the two. The “Total Foreign Dependency” strategy (factor) was ranked significantly lowest.

These results reflect the LDC stakeholders’ beliefs on how sustainable teledensity growth is best achieved. The favored self-sufficiency and regional/foreign alliance strategies call for reliance on locally or regionally manufactured telecommunications equipment, modern infrastructure, and well-trained local personnel.

In order to build up the capabilities for local manufacturing, African LDCs could learn from the Indonesian experiences that have enabled Indonesia to spur its teledensity growth and become a major exporter of telecommunications equipment to the world (Parapak, 1994). Other researchers have argued that local manufacturing capability would ensure rapid development of telecommunications services in LDCs (Olanrewaju, 1995). This could be a major step toward freeing African LDCs from their current over-dependence on foreign countries.

As for the “African Regional/Foreign Alliance” strategy, African LDCs, with assistance of funding organizations, could set up long-term contracts to acquire the necessary knowledge from developed countries. We believe that joint venture strategies would be better than total foreign dependency. Also, development organizations should conduct seminars to improve the qualifications of experts of African LDCs. Such an alliance could be the basis of a transition to self-sufficiency, with little dependence on foreign countries.

The feedback comments from many stakeholders who participated in this study reflect a general sentiment against the perpetual foreign dependency. The significantly low ranking reported for “total foreign dependency” also reflects this sentiment. One stakeholder commented:

“I think this issue of the foreign countries helping us should be in the short term since they have it now and we must learn and be able to start doing it on our own and become independent.”

Feedback from other stakeholders was that African LDCs should not depend on developed countries to build and install their telecommunications equipment. Furthermore, many stakeholders felt that when purchasing equipment from foreign countries, African LDCs should avoid tying themselves into contracts that include long-term commitments clauses for the supply of spare parts and post-installation review.

With regards to “Total Foreign Dependency”, one stakeholder had this to say:

“The problem of African countries is mainly the transfer of technology and know-how to their nationals. Perpetual dependency on expatriates for what amounts to “black-box” style installation and maintenance will not help to develop the necessary know-how among the nationals for the development and maintenance of the systems. Thus, I believe in the importance of transfer of technology and know-how to nationals as a step towards sustainable development, and I also believe that intra-African co-operation can lead to better results in negotiating the transfer of technology.”

In summary, the stakeholders’ advocate “Self-Sufficiency” and “African Regional/ Foreign Alliance” as a major step towards sustainable development of the technologies needed for sustainable growth of teledensity. Furthermore, the stakeholders felt that African LDCs should avoid following the “viagra” approach, whereby African LDCs hire or depend on transient foreign experts whose engagements have proved to be ineffective and too expensive for most of Africa’s LDCs.

As earlier reported, there was a significant difference between governmental and non-governmental stakeholders' perceptions on how best to improve the low teledensity in Africa's LDCs. The two stakeholder groups differ significantly in their perceptions of the effectiveness of strategies ($p < 0.001$ for main effect). However, there was no significant difference in the main effect based on affiliation. This implies that the stakeholders did not differ significantly in their perceptions based on whether their affiliations were as telecommunications operator, telecommunications regulator, and academia, research centers, and/or development agency. Also, there was no evidence of significant interaction effect between affiliation and group. As shown in Table 8, affiliation * group interaction = 0.894.

Based on the post-hoc ANOVA results, the governmental stakeholders (GSH) were stronger advocates of "Self-Sufficiency" in technology-oriented strategies than their non-governmental (NGSH) counterparts. This suggests that many government stakeholders have an interest in government controlling local production of telecommunications equipment.

IMPLICATIONS AND FUTURE RESEARCH OPPORTUNITIES

Implications

Analysis of the data from the study points to the desire of stakeholders in Africa's LDCs to be self-sufficient by learning to build, operate, and maintain their own equipment, as well as establishing strategic regional alliances. The findings in this study can be used to provide prescriptive directions to policy makers of Africa's LDCs and development agencies to improve their teledensity growths. These policy-makers could explore and analyze the strategies mentioned in this study, as well as examples of success stories of countries that have used similar

technology-oriented strategies to improve their levels of teledensity. It is already documented in the literature that a sound and well-managed telecommunications system is a key ingredient of economic development of any country.

Future Research

This study provides an impetus for further research opportunities in the general arena of telecommunications, particularly with respect to Africa, which, arguably, is the least studied continent when it comes to Information Systems issues in general.

To build on this study, future studies that involve much larger sample sizes of stakeholders from different LDCs of Africa should be conducted. Such a study would provide better insights about factors that are unique to certain countries. A future study might explore the use of the Delphi Method, Nominal Group Technique, or other approach to help expand the number of factors or strategies that may be more relevant to Africa is needed. The appropriate alignment of constraints to strategies could be done the future as well. Yet another study may involve longitudinal multi-method investigation of the various countries in order to monitor the progress of teledensity growth efforts.

Due to the infancy of Information Systems research efforts on Africa, the opportunities for future studies even in the one area of telecommunications diffusion seem unlimited. From the socio-cultural standpoint, there could be a series of studies to understand how Africa and parts thereof differ from other parts of the world in technology diffusion issues in general. From the foregoing, we have only begun to explore the tip of the iceberg of Information Systems related studies that could impact the technological development of many parts of Africa.

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