Towards a model of consumer use of mobile information and communication technology in LDCs: the case of sub-Saharan Africa

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Abstract. *Using theories of technology acceptance and technology transfer, we identified factors affecting the use of mobile information and communication technology (mobile ICT) in the least developed countries (LDCs), specifically sub-Saharan Africa. From a literature review, we developed a research model to describe factors that impact mobile ICT use and formulated a series of hypotheses about them. We then surveyed mobile ICT users in Kenya and Nigeria and created a structural model to examine our hypothesized relationships. Our findings indicate that access to mobile ICT, and cultural influences on mobile ICT diffusion, strongly influence individuals' perceptions of the usefulness and ease of use of mobile ICT. Individuals' perceptions about the reliability of mobile ICT influence use of these technologies significantly. The results suggest that, although extensive ICT diffusion (high mobile ICT levels per capita) may be necessary for seeding commercial and economic initiatives that depend heavily on mobile ICT, such as m-commerce, it may not be sufficient. Firms conducting business in sub-Saharan Africa need to pay attention to the factors that explain individual mobile ICT use because these factors will most likely determine the optimal market segmentation, business development and customer service strategies for leveraging m-commerce operations in that region. For government units, the understanding of such factors would also be beneficial in aiding economic planning and commerce.*

Keywords: mobile ICT, LDCs, technology acceptance, accessibility of technology, m-commerce, sub-Saharan Africa

INTRODUCTION

The global diffusion of mobile information and communication technology (mobile ICT) has been unprecedented, expanding from 50 million in 1999 to over one billion by the end of

2002 (ITU, 2002; UNCTAD, 2002). Mobile ICT growth is especially pronounced in emerging and least developed countries (LDCs), where for decades a vast majority of consumers have been unable to access ICT (De Vreede *et al*., 1998; Meso & Duncan, 2000; ITU, 2002). Sub-Saharan Africa, for example, has more than 26 million mobile-phone subscribers and a mobile phone density of 1.13 per 100 inhabitants. Conversely, the total number of fixed-line subscribers stands at only 21 million, with a teledensity – number of phone lines per 100 people – of 0.79 (see Appendix 1). By the end of 2001, 28 of Africa's 54 countries had more mobile-phone than fixed-line subscribers – 51%, a higher percentage than in any other continent (ITU, 2002; Mbarika *et al*., 2002a). In contrast, the fixed-line telephone density remains far below 1 for most of sub-Saharan Africa (Mbarika *et al*., 2002b). According to the International Telecommunications Union, a teledensity of 1 is the level at which ICT begins to significantly affect a nation's social and economic development (ITU, 2002; Mbarika *et al*., 2002b).

The growth of mobile telephony is significant because most researchers agree that widespread acceptance of mobile ICT is a precursor to a region's ability to conduct mobile e-commerce (m-commerce), commonly defined as the use of wireless ICT, such as mobile phones and personal data assistants for buying and selling goods and services, or the use of wireless ICTs for transactional and business-related communications among individuals and companies – communication that does not necessarily involve financial transactions. If so, developed nations seem poised to develop m-commerce quite rapidly, but more study is needed on how to further m-commerce within developing countries. However, most information systems research efforts in developing countries have focused on the extent to which ICT diffusion has occurred (Odedra *et al*., 1993; Collings, 1996; Meso & Duncan, 2000; Mbarika *et al*., 2002a); on how cultural differences affect ICT diffusion; (Karahanna *et al*., 1999; Olesen & Myers, 1999; Walsham, 2002) or on individual business applications (Nidumolu *et al*., 1996; Madon, 1997; Martinsons & Westwood, 1997; Light, 1999; Minges, 1999). Even the wealth of practitioner knowledge on successful m-commerce inception and growth within developing countries is based on anecdotal evidence from a limited number of companies (Anandarajan *et al*., 2000; Vasan, 2001; UNCTAD, 2002).

Research on end-user computing (Davis, 1989; Igbaria & Chidambaram, 1997; Igbaria *et al*., 1997; Straub *et al*., 2002; DeLone & McLean, 2003), ethnography of information systems (Harrison *et al*., 1997; Myers, 1999; Walsham, 2002) and information technology (IT) adoption (Martinsons & Westwood, 1997; Agarwal & Karahanna, 2000; Gefen & Straub, 2001; Chatterjee *et al*., 2002; Walsham, 2002; Legris *et al*., 2003) suggests that factors other than the technology itself affect the successful use of ICT to enable business – even within developing countries. Yet few research efforts aim to understand individual mobile ICT users or to study the impact of use patterns on m-commerce. Most studies with this focus are just now getting published (Grover & Ramanlal, 1999; Minges, 1999; Agarwal & Karahanna, 2000; Chatterjee *et al*., 2002; Grover *et al*., 2002; Mbarika *et al*., 2002b; Gefen *et al*., 2003), and their context is developed countries. No academic research has systematically and rigorously studied the key factors to mobile ICT use within developing countries using data collected directly from individual consumers.

We believe that the proliferation of mobile ICT may not be enough to ensure the establishment and growth of m-commerce in developing countries and that the way individual consumers use the technology could also be a key factor. To validate this belief and identify other technology acceptance factors, we decided to study possible drivers of mobile ICT use in sub-Saharan Africa. Our study aimed to answer the question:

> What are the technology acceptance factors that explain the use of mobile ICTs by individual end-users in sub-Saharan Africa?

Given that there is no clear single measure for mobile ICTs, we use mobile phones as a surrogate for mobile ICT. Researchers have found that the adoption of telephones is a good surrogate of ICT adoption in general (Mbarika *et al*., 2002b). In the same vein, we assume that mobile-phone use is a good surrogate for measuring mobile ICT use. Therefore, we use the results obtained from observing and measuring mobile-phone use to draw inferences on the nature of mobile ICT use in sub-Saharan Africa.

We chose to study sub-Saharan Africa for several reasons. First, there is a dearth of research on information systems (IS) and ICT in this region. After searching four journals dedicated to IS research – *MIS Quarterly, Information Systems Research, Journal of MIS* (JMIS) and *Journal of the AIS* – using guidelines on IS journal rankings (Mylonopoulos & Theoharakis, 2001), (Whitman *et al*., 1999) we found only one article in JMIS related to sub-Saharan Africa (De Vreede *et al*., 1998). Second, the region has witnessed meteoric growth in mobile ICT density in the past 3 to 5 years and is credited with having the fastest teledensity growth in the world (ITU, 2002; UNCTAD, 2002). The impacts of mobile ICT use on society may therefore be more magnified and easily visible here than in other parts of the world, where marginal utility from mobile ICT use has plateaued. Third, because many researchers believe that mobile ICT has significant impact on social and economic development and because the sub-Saharan region contains 33 of the current 48 LDCs, the region is an excellent context for assessing the effects of ICT on society, individuals and nation states (See Appendix 2).

In this paper, we describe our use of technology adoption and technology transfer theories (Davis, 1989; Igbaria *et al*., 1997; Straub *et al*., 1997; Gefen *et al*., 2003), in identifying key factors that determine an individual's use of mobile ICT. We begin by providing a research model used to characterize possible factors. We then present the hypotheses we developed about those factors, the data collection approach, a partial least squares analysis of the research model and our results. We conclude with implications for future research.

RESEARCH MODEL

Figure 1 provides our research model and hypotheses. Our objective is to examine key factors that influence mobile ICT use, specifically mobile phone usage, by individuals in a developing country context where mobile ICT devices and their use are still emerging. Therefore, we selected from published literature those factors theorized as having strong influences in shap-

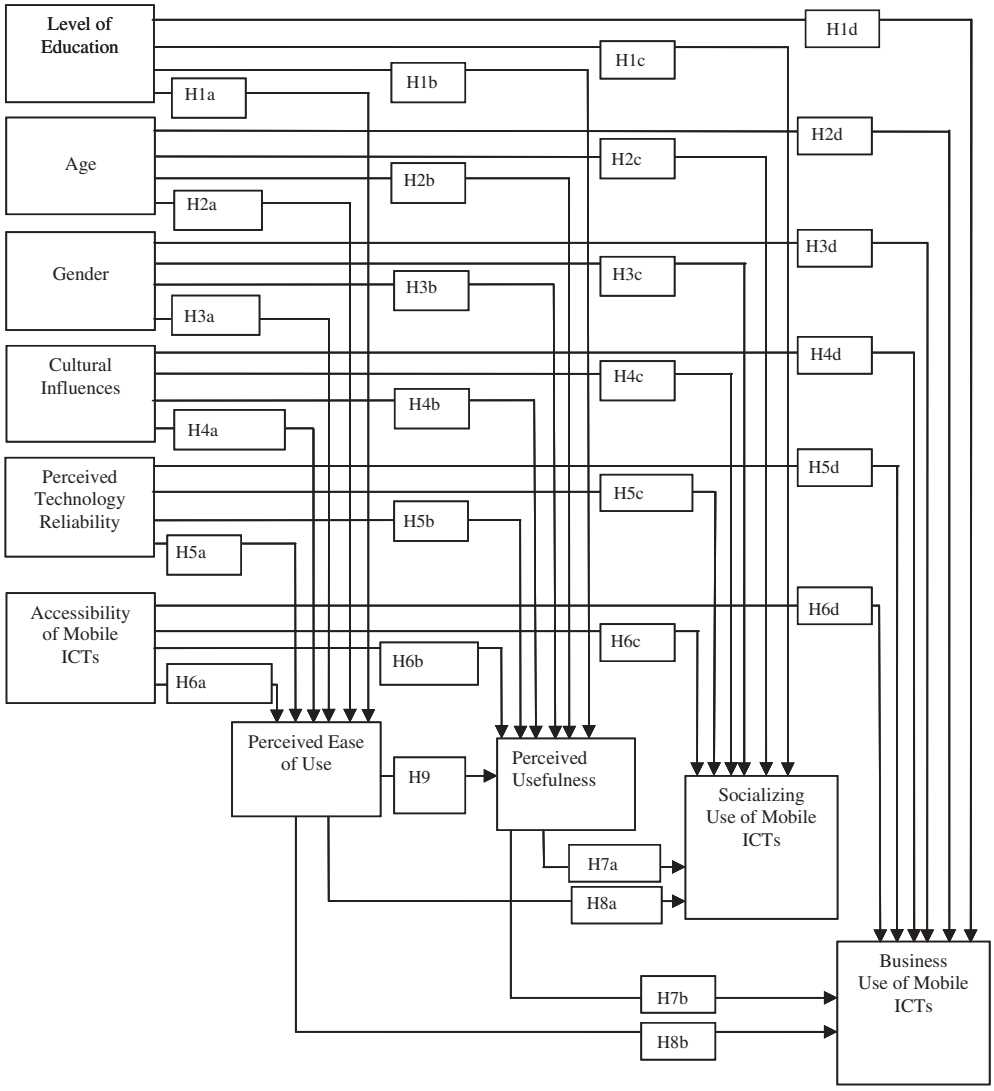

Figure 1. Research model and hypotheses.

ing usage behaviour. These factors were then associated to actual mobile ICT usage, and to individuals' perceptions of mobile ICTs, to form our research model.

Our research model has eight factors that might influence mobile ICT use, which we derived from past research on ICT adoption and technology transfer. These factors may serve to (1) explain mobile ICT use and/or (2) to differentiate mobile ICT users. In this study, we focus exclusively on the explanatory aspects of these factors. We posit that all eight fac-

tors may influence individual use of mobile ICTs. Understanding the patterns of how individual mobile ICT use evolves will help firms shape appropriate market strategies for the establishment and development of m-commerce ventures in sub-Saharan Africa. Such understanding will also benefit researchers, who would then have a basis on which to gain more insights into the implementation, strategic relevance, and planning of business and economic initiatives that are dependent on mobile ICTs, such as m-commerce operations, in this region.

According to technology adoption theory and research on technology use, the factors normally used to profile individuals – **education level** (Bramley, 1989; Bunning, 1992; Mullen & Lyles, 1993; Alavi, 1994; Davis, 2000; Piccoli *et al*., 2001), **age** (Appelbaum, 1990; Brosnan, 1999; Harris & Davison, 1999) and **gender** (M.A. Bolling, unpublished manuscript; Agarwal *et al*., 1997; Gefen & Straub, 1997; Venkatesh & Morris, 2000; Ono, 2003) – influence technology use. The **perceived cultural influences** (Walsham & Sahay, 1999; Walsham, 2002; Kim, 2003; Rose *et al*., 2003) on acceptable usage of the technology, and the **perceived reliability** (Anandarajan *et al*., 2000; Venkatesh & Morris, 2000; Gefen *et al*., 2003; Legris *et al*., 2003) of the technology, can also have a bearing on how individuals elect to use technology. **Access** is perhaps the most accepted determinant of individual use (Anandarajan *et al*., 2000; Majchrzak *et al*., 2000; Vasan, 2001; Agarwal & Venkatesh, 2002).

Research has also shown that individuals' perceptions about a technology influence their acceptance and subsequent adoption of the technology. The key constructs for examining individuals' perceptions in past adoption studies have been **perceived usefulness** and **perceived ease of use** (Rose & Straub, 1998; Grover & Ramanlal, 1999; Venkatesh, 1999; Gefen *et al*., 2003). These two factors are taken from the Technology Acceptance Model (TAM), developed by Davis (1989), and having its theoretical underpinnings in the Theory of Reasoned Action (Davis, 1989). As elaborated in Figure 2, TAM specifies causal linkages between two key sets of constructs: (1) Perceived Usefulness (PU) and Perceived Ease of Use (PEOU); and (2) and actual usage behaviour (U) (Davis, 1989). PU is defined as the user's 'subjective probability that using a specific application system will increase his or her job performance within an orga-

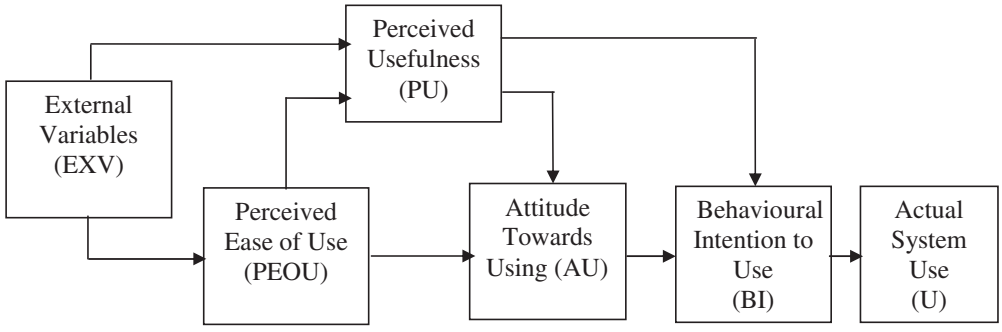

Figure 2. Technology Acceptance Model (Davis, 1989; Chin, 2000).

nizational context' (Davis, 1989, p. 985), while PEOU is defined as 'the degree to which the user expects the target system to be free of effort' (Davis, 1989, p. 985). According to TAM, both PU and PEOU predict U through their influence on attitude towards using a technology (AU) and behavioural intention to use a technology (BI).

TAM was developed as an attempt 'to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified' (Davis, 1989, p. 985). It has since grown to become the leading theoretical model for explaining ICT adoption in information systems research (Straub *et al*., 1997; Venkatesh, 1999). We adopted the perception variables from TAM in the development of our research model.

The way that an individual uses ICT – whether primarily for business or more for socializing – is also important. In business use, the individual uses mobile ICT to transact personal business with other individuals or corporate entities and to conduct business communications (Adams *et al*., 1993; DeSanctis & Poole, 1994; Zack & Mckenney, 1995; Minifie, 1996; Bennett & Weill, 1997; Michel, 1997). In socializing use, an individual views mobile ICT predominantly as a way to socialize with family, peers and friends (Howard, 1992; Ostroff & Kozlowski, 1992; Myers, 1999; Wiesenfeld *et al*., 1999).

Although m-commerce is likely to benefit more from the use of mobile ICT for business transactions than for socializing, socializing use is an important first step towards business use. Indeed, early stages of adopting a technology are characterized by the use of devices as tools for communication and socializing rather than for economic activity and business. Currently, socializing use of mobile ICT is more prevalent than business use in sub-Saharan Africa. ICT devices are a relatively new acquisition for most people; in fact, many have been able to own their very first phones only because of mobile ICT (Mbarika *et al*., 2002a). Thus, many users are still transitioning through the early stages of technology-use behaviour. Another reason for predominantly socializing use is that ICTs have been culturally perceived as being devices for communication and symbols of social progress rather than as being business tools. Indeed, some mobile ICT users were motivated to adopt the technology just for the status of having it (Mbarika *et al*., 2002a).

HYPOTHESES ABOUT INDIVIDUAL USE

We provide a brief justification of each factor and the hypotheses derived therefrom in the ensuing paragraphs.

Education level

Research has established that advanced education influences an individual's capability to use technology (Alavi, 1994; Davis, 2000; Piccoli *et al*., 2001). Unfortunately, the opportunity for

higher education in sub-Saharan Africa remains limited: only 3% of 18- to 25-year-olds are able to attend college (Light, 1999). To determine if education does influence adoption behaviour with respect to mobile ICT, we hypothesized that:

H1: Education level will positively influence individual end-users':

(a) perceptions of the ease of use of mobile ICT;
(b) perceptions of the usefulness of mobile ICT;
(c) reported socializing use of mobile ICT;
(d) reported business use of mobile ICT.

Age

The theory of technology adoption also points to age as a factor that influences when and how an individual adopts new technologies. Studies on cyberphobia indicate that age is a key factor in the adoption of technology, with older people tending to exhibit higher phobic levels. Consequently, these individuals tend to adopt new technologies much more slowly than younger users (Appelbaum, 1990). Therefore, concerning adoption of mobile ICTs in sub Saharan Africa, we hypothesized that:

H2: Age will influence individual end-users':

(a) perceptions of the ease of use of mobile ICT;
(b) perceptions of the usefulness of mobile ICT;
(c) reported socializing use of mobile ICT;
(d) reported business use of mobile ICT.

Gender

Gender and technology studies have found that men and women adopt technology differently (Gefen & Straub, 1997; Venkatesh & Morris, 2000). Men's decisions to use technology are more strongly influenced by their perception of usefulness, while women's decisions are based more on perceptions of the technology's ease of use (Venkatesh & Morris, 2000). Women and men differ in their perceptions of, but not their use of, email technology. Further, men and women may view the same mode of communication differently (Gefen & Straub, 1997; Ono, 2003). We hypothesized that:

H3: An individual's gender will positively influence individual end-users':

(a) perceptions of the ease of use of mobile ICT;
(b) perceptions of the usefulness of mobile ICT;
(c) reported socializing use of mobile ICT;
(d) reported business use of mobile ICT.

Culture

Many studies have determined that culture has a strong contextual influence on whether and how individuals, organizations and societies use ICT (Hofstede, 1991; Myers, 1999; Walsham, 2002; Kim, 2003; Rose *et al*., 2003). These findings demonstrate that: (1) technology diffusion differs across cultures; (2) the technology-diffusion patterns in a given culture are influenced by the culture's beliefs, norms and values, among other cultural dimensions; and (3) different cultures tend to prefer different technology. Therefore, we expect cultural influences on the individual to impact how the individual uses mobile ICT.

H4: Perceived cultural influences on mobile ICT diffusion will positively affect individual end-users':

(a) perceptions of the ease of use of mobile ICT;
(b) perceptions of the usefulness of mobile ICT;
(c) reported socializing use of mobile ICT;
(d) reported business use of mobile ICT.

Perceived technology reliability

The TAM identifies user perceptions about a technology as being key determinants of whether the technology gets used (Anandarajan *et al*., 2000; Venkatesh, 2000; Gefen *et al*., 2003; Legris *et al*., 2003). Although the two types of perceptions that have been extensively studied are a technology's perceived ease of use and its perceived usefulness, we expect that perceptions about a technology's reliability will also influence the degree to which the technology is used. Individual consumers are bound to be less confident in a technology that is not reliable and would thus limit its use. This leads us to hypothesize that:

H5: Individuals' perceptions about the reliability of mobile ICT will positively influence individual end-users':

(a) perceptions of the ease of use of mobile ICT;
(b) perceptions of the usefulness of mobile ICT;
(c) reported socializing use of mobile ICT;
(d) reported business use of mobile ICT.

Accessibility of technology

ICT use also depends on the technology's degree of accessibility and ready availability (Madon, 1997). TAM presumes that the technology being studied is readily accessible. In situations where access to the technology is not limited or constrained by any set of extenuating circumstances, the attitude towards using the technology and subsequently the intention to use the technology are shaped by a subject's perception of the technology. However, where access

to the technology is constrained, the subject's attitude towards adopting the technology is, to some extent, affected by whatever impediments exist to constrain their accessing the technology. This has been the situation for most of the technology users in resource-poor countries such as those in sub-Saharan Africa (Madon, 2002).

We therefore posit that accessibility of technology influences a subject's perceptions about the technology. Further, we argue that constrained access influences the subject's perceptions about the technology's true usefulness and ease of use. For one, where the technology cannot be readily accessed, subjects are prone to perceive the technology as not being easy to use, when in fact it is easy to learn how to use the technology and relatively simple to apply the technology to the performing or relevant applications. We also argue that where access is greatly constrained, subjects may place a higher value on the technology than its true usefulness – perceiving it to be more useful (or as deriving greater utility – in economic terms), than is actually the case. This leads us to hypothesize causal relationships between accessibility of mobile ICTs and the TAM antecedents PU and PEOU respectively.

H6: The reported accessibility of technology will influence individual end-users':

(a) perceptions of the ease of use of mobile ICT;
(b) perceptions of the usefulness of mobile ICT;
(c) reported socializinguse of mobile ICT;
(d) reported business use of mobile ICT.

TAM antecedents

Traditional TAM studies have indicated that many factors drive the acceptance of a given technology (Anakwe *et al*., 1999; Agarwal & Karahanna, 2000; Majchrzak *et al*., 2000). Davis (1989) identified two key factors that influence the decision to adopt a specific technology: perceived ease of use and perceived usefulness. Past studies on TAM have consistently supported the significance of these factors in influencing adoption behaviour. Further, these studies have shown that perceived ease of use also influences perceived usefulness. Borrowing from this stream of research, we develop hypotheses H7, H8 and H9 (Anakwe *et al*., 1999; Agarwal & Karahanna, 2000; Majchrzak *et al*., 2000; Mbarika *et al*., 2002b).

H7: End-users' perception of mobile ICT's usefulness will positively affect the reported:

(a) socializing use of mobile ICT by individual end-users;
(b) business use of mobile ICT by individual end-users.

H8: End-users' perception of mobile ICT's ease of use will positively affect the reported:

(a) socializing use of mobile ICT by individual end-users;
(b) business use of mobile ICT by individual end-users.

H9: Perceived ease of use of mobile ICT will positively affect the perceived usefulness of mobile ICT.

RESEARCH METHOD

Data collection

We used a survey to empirically examine and evaluate the 15 hypotheses, basing the survey instrument on technology transfer, technology diffusion and end-user computing literature. We developed the survey instrument – a questionnaire – to measure individuals' perceptions of technology and core factors that we thought would influence an end-user's reaction to mobile ICT. The constructs that were used in the study and their respective survey items are presented in Appendix 3.

In constructing the instrument, we gave preference to previously tested questions and followed generally accepted guidelines for building survey instruments (Igbaria *et al*., 1997; Wixom & Watson, 2001; Gefen *et al*., 2003). We developed all survey items – age, gender, education level, perceived usefulness, perceived ease of use, perceived reliability, access, cultural influences and uses of mobile ICT – from validated instruments and used them only when the existing literature adequately supported them.

We gave the initial survey instrument to researchers from US academic institutions with specific expertise in technology transfer and IT diffusion in Africa. We then used their input to refine and restructure the instrument and establish its content validity. Finally, we pilot-tested the instrument with five academicians and practitioners who were natives of sub-Saharan Africa to identify problems with wording, content, structure, format and procedures. The pilot participants returned written comments, and we followed up with each one via telephone for more detailed feedback. We used their recommendations to develop the final version of the instrument.

We then sent 450 hard-copy questionnaires to two agent organizations in Nigeria and 150 to two similar organizations in Kenya. The agent organizations have several branch offices in the respective countries, and they distributed the questionnaires to each of their branch offices. The branch offices administered the questionnaires by getting their clients to complete the survey, by disseminating the questionnaires at local universities and polytechnic institutes, and by delivering them personally to technical officers at government ministries. We offered no incentives for completing the questionnaire.

Sub-Saharan Africa, as a region, is geographically rather large and surveying each individual country proved impractical. Therefore, for this study, we elected to limit our data collection to Nigeria and Kenya. These two countries are regional economic and travel hubs in west Africa and east Africa, respectively, and have experienced significant diffusion in a wide array of ICT, especially the mobile telephony and internet-related applications. Further, these two countries are relatively more politically stable than most of their surrounding countries in the region (CIA, 2004; USAID, 2004). They both use English as the formal language and the language for education. This allowed for the effective administration of the survey instrument without the need for translators or intermediation.

As Table 1 shows, we received 198 responses from 122 males and 76 females – a 33% response rate. Of the 198 respondents, 8 did not indicate that they used mobile ICTs. Given

Table 1. Descriptive statistics of respondents by country

Item	Country	Valid N	Minimum	Maximum	Mean	SD	Difference in mean	*P*-value
Age	Both	187	18	60	32.813	8.649	3.1	0.05
	Nigeria	150	20	60	33.427	8.835		
	Kenya	37	18	60	30.324	7.450		
Education level*	Both	165	1	6	3.879	0.832	0.48	0.003
	Nigeria	131	2	6	3.977	0.827		
	Kenya	34	1	5	3.500	0.749		
Cultural* influence q14	Both	192	1	6	2.86	1.58	0.44	0.132
	Nigeria	156	1	6	2.78	1.51		
	Kenya	36	1	6	3.22	1.82		
Cultural* influence q15	Both	196	1	6	2.77	1.64	1.62	0.000
	Nigeria	159	1	6	2.46	1.54		
	Kenya	37	1	6	4.08	1.40		
Cultural* influence q16	Both	195	1	6	3.1	1.31	0.33	0.173
	Nigeria	158	1	6	3.16	1.26		
	Kenya	37	1	6	2.84	1.52		
Cultural* influence q17	Both	195	1	6	1.48	0.80	0.34	0.072
	Nigeria	158	1	6	1.42	0.71		
	Kenya	37	1	6	1.76	1.06		

*Likert scale of 1–6 used to measure education level with: 1, no formal schooling; 2, primary certificate; 3, high school certificate; 4, bachelor's degree or equivalent; 5, master's degree or equivalent; and 6 = doctoral degree or equivalent; N, number of cases used in determining mean and standard deviation (SD).

that the method of data analysis that we used allows for missing data cases to be included in the statistical tests, we did not exclude these 8 cases.

The respondents ranged in age from 18 to 60 years and had an average work experience of 8.18 years. On average, the respondents indicated that they had completed at least a high school education. We used the Likert scale to measure all survey items, except those that provided personal information about the individual.

A comparison of the responses from the two countries indicated that they did not differ in their rating of cultural influences on the use of mobile ICT, except for one item (question 15). However, there was a significant difference in the mean age, and education level of respondents. As reflected in the data analysis section, these two factors had no significant influence on how individuals used mobile ICT – even when the respondents from each country are tested independently. This being the case, we found no justification for separating the data into two samples based on country or respondents.

Data analysis

We tested the research model using Partial Least Squares (PLS), a structural modelling technique well suited for highly complex predictive models (Joreskog & Wold, 1982; Chin, 1997; Wixom & Watson, 2001; Gefen *et al*., 2003). PLS has several strengths that make it appro-

priate for this study, including its ability to handle formative constructs, small sample sizes and missing values (Chin, 1998). As Wixom and Watson (Wixom & Watson, 2001) document, the technique concurrently tests the psychometric properties of scales used to measure variables in the model (the measurement model) and analyses the strengths and directions of the relationships among variables (the structural model).

For the measurement model, PLS makes it possible to estimate the instrument items' internal consistency, convergent validity and discriminant validity. Wixom & Watson (2001), Chin & Newsted (1999) and Fornell & Larckner (1982) point out that the assessment of internal consistency is normally performed for the reflective items in the measurement model only. Table 2 lists the reflective items and their internal consistency reliabilities. All reliability measures were above the recommended level of 0.60 for exploratory research (Nunnally, 1967; Wixom & Watson, 2001).

For satisfactory discriminant validity, the average variance extracted (AVE) for each construct should be greater than the variance shared between the construct and other constructs in the model (Fornell & Bookstein, 1982; Wixom & Watson, 2001; Gefen *et al*., 2003). Table 3

Table 2. Assessment of internal consistency reliability and convergent validity

		Item Loading				
Factor	Internal consistency reliability	Indicator (Appendix 3)	Loading	Mean of subsamples	Standard error	*t*-Statistic
Accessibility of mobile ICT	0.688	q23	0.4181	–0.3676	0.1478	–2.8295**
		q47_e	0.9727	–0.9746	0.0181	–53.851**
Perceived reliability	0.823	q56	0.7265	–0.7252	0.0757	–9.6034**
		q13	–0.936	–0.9409	0.0146	–64.3003**
Cultural influences	0.911	q57	0.7458	0.739	0.1429	5.2202**
		q58	0.9355	0.9342	0.047	19.8887**
		q59	0.8728	0.8411	0.187	4.6664**
		q63	0.828	0.7409	0.3159	2.6215**
Age	1	q1_a	1	1	0	0
Education	1	q2	1	1	0	0
Gender	1	q1_b	1	1	0	0
Perceived ease of use	0.927	q49_g	0.9198	0.92	0.0227	40.4655**
		q50_g	0.9423	0.9445	0.0144	65.3678**
		q53_g	0.939	0.9379	0.0173	54.3133**
Perceived use	0.953	q51_g	0.9457	0.9445	0.0086	110.5057**
		q54_g	0.9131	0.9075	0.0257	35.5127**
Socialization use	0.688	q14_d	0.4113	–0.4114	0.1019	–4.0376**
		q14_e	0.6197	–0.6181	0.0776	–7.9903**
		q15_a	0.8847	–0.883	0.0335	–26.3911**
Business use	0.754	q14_a	0.5493	0.5385	0.0826	6.6509**
		q14_b	0.7059	0.7095	0.0825	8.5524**
		q15_b	0.8602	0.8589	0.0302	28.4991**

*Indicates that the item is significant at the $P < 0.05$ level ($t > 1.96$).

**indicates that the item is significant at the $P < 0.01$ level ($t > 2.57$).

Table 3. Correlation matrix with AVE scores

	Accessibility	Perceived reliability	Cultural influences	Age	Level of education	Gender	PEOU	PU	Socialization use	Business use
Accessibility	0.749									
Perceived reliability	–0.326	**0.838**								
Cultural influences	–0.119	0.026	**0.848**							
Age	0.172	–0.237	–0.015	**1**						
Level of education	0.075	–0.019	–0.071	0.326	**1**					
Gender	0.175	–0.076	–0.023	0.516	0.377	**1**				
PEOU	–0.613	0.26	0.254	–0.176	–0.026	–0.116	**0.930**			
PU	–0.655	0.258	0.265	–0.15	–0.028	–0.09	0.921	**0.934**		
Socialization use	–0.171	0.595	0.069	–0.155	–0.116	–0.094	0.11	0.096	**0.667**	
Business use	0.038	–0.592	0.041	0.165	0.053	0.078	–0.038	–0.023	–0.401	**0.716**

lists the correlation matrix, with the AVE of each construct listed on the diagonal. It is evident from the table that all constructs satisfied the discriminant validity.

Convergent validity is adequate when constructs have AVE of at least 0.5 (Fornell & Bookstein, 1982; Gefen *et al*., 2000; Wixom & Watson, 2001). Convergent validity is also satisfied, as all AVEs are greater than 0.5. Convergent validity is also demonstrated when items load highly (greater than 0.5) to their respective reflective constructs (Wixom & Watson, 2001). Table 2 shows the factor loadings of each item on their associated constructs. All but two items has loadings greater than 0.5. Reviewing both AVEs and item loadings, we are satisfied that the model meets the requirements for adequate convergent validity.

RESEARCH RESULTS

In PLS, the structural model tests, which entail estimating the path coefficients and the R^2 values, provide the information necessary to assess the hypotheses in a research model. *Path coefficients* represent the strength of the relationships between dependent and independent variables. These need to be significant and directionally consistent with expectations. The R^2 *value* represents the amount of variance explained by the independent variables, thereby providing insights into the model's predictive power. Together, both explain how well the structural model is performing. The greater the R^2 value, the better the model's predictive quality (Fornell & Bookstein, 1982; Joreskog & Wold, 1982; Chin & Newsted, 1999; Wixom & Watson, 2001). Therefore, results for hypotheses 1 through 9 were determined by running the bootstrap resampling method (with 100 resamples) in PLS. The sample size of 198 was well above the recommended minimum of 40 for model testing (Wixom & Watson, 2001). Figure 3 presents the results of the analysis.

Perceived technology reliability and perceived usefulness together accounted for 80.3% of the variance in business use and 62.2% of the variance in socializing use of mobile ICT, respectively. Despite these factors demonstrating significant influences on business use and socializing use of mobile ICT, the relatively moderate R^2 values of 0.384 and 0.374, respectively, indicate that other factors need to be taken into account to further explain mobile ICT use in sub-Saharan Africa. The same is true for the perceived ease of use construct whose R^2 value is 0.420. Accessibility of mobile ICTs, accounting for 56.4% of the variance in perceived ease of use construct, was the dominant influence of user perceptions about the ease of use of a technology. Perceived ease of use and accessibility of mobile ICTs were the main influences on perceived usefulness, accounting for 81.7% and 15.7% of its variance, respectively. The R^2 value for perceived usefulness was 0.865. This indicates that accessibility is also a key influence of individuals' perceptions about the usefulness of mobile ICTs.

As in previous studies based on TAM, perceived ease of use had a significant impact on perceived usefulness of mobile ICT (t-value = 19.7115), thereby lending support for hypothesis H9 (Table 4). These results are interesting especially within the context of promoting mobile ICT use as vehicles of economic activity such as m-commerce. We discuss them further in the ensuing section.

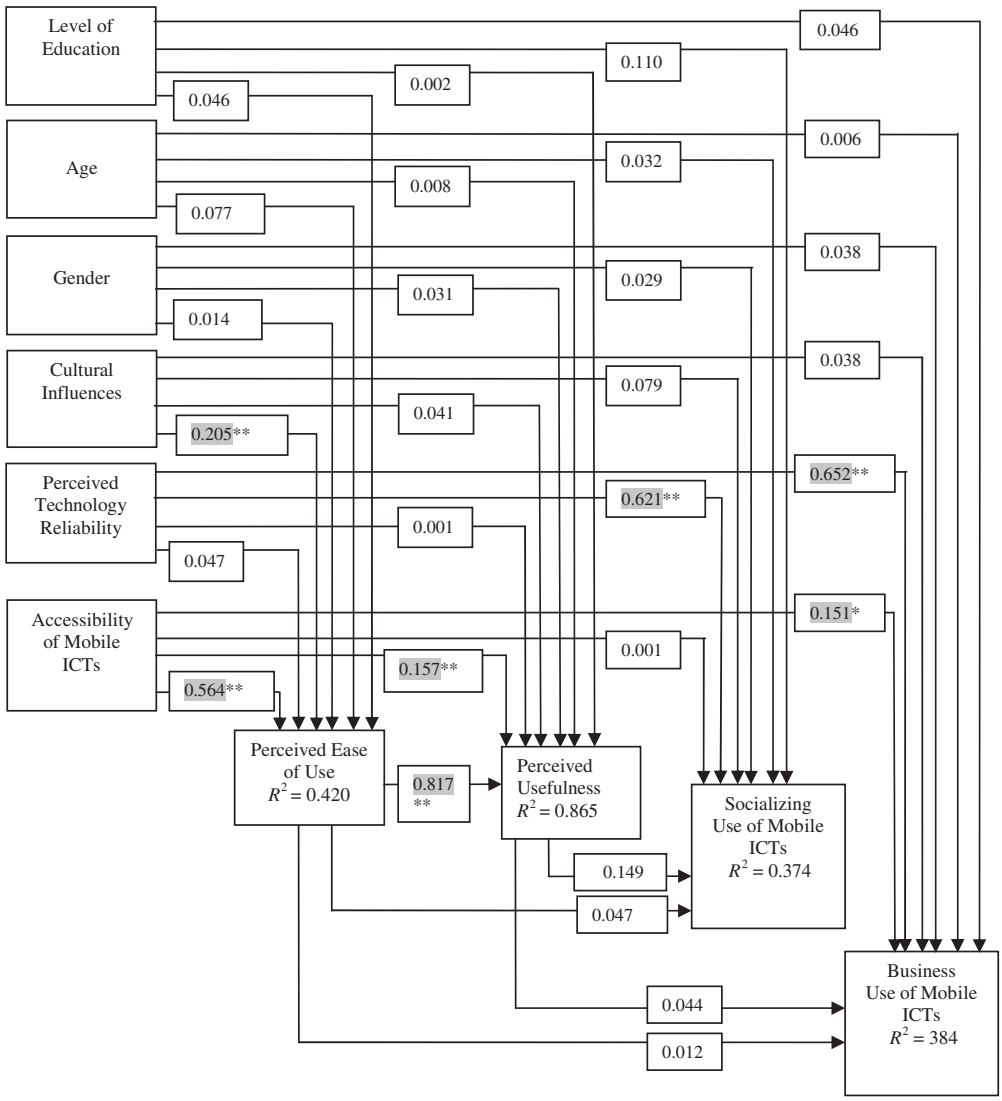

Figure 3. Results of PLS graph analysis of business and socializing use of mobile ICT.
*indicates that the item is significant at the $P < 0.05$ level ($t > 1.96$).
**indicates that the item is significant at the $P < 0.01$ level ($t > 2.57$).

Cultural influences significantly influenced perceived ease of use (t-value = 2.6485). Perceived technology reliability significantly influenced socializing use (t-value = 14.6031) and business use (t-value = 9.9377) of mobile ICT, while accessibility of mobile ICT significantly influenced perceived ease of use (t-value = 3.0271) and perceived usefulness (t-

Table 4. Summary listing of supported hypotheses

	Hypothesis	Path coefficient	*t*-value
H4a	Perceived **cultural influences** on mobile ICT diffusion will positively affect individual end-users' perceptions of the **ease of use** of mobile ICT.	0.205	2.6485
H5c	Individuals' **perceptions about the reliability of mobile ICT** will positively influence individual end-users' reported **socializing use** of mobile ICT.	0.621	14.6031
H5d	Individuals' **perceptions about the reliability of mobile ICT** will positively influence individual end-users reported **business use** of mobile ICT.	0.652	9.9377
H6a	The reported **accessibility of technology** will influence individual end-users' **perceptions of the ease of use** of mobile ICT.	0.564	3.0271
H6b	The reported **accessibility of technology** will influence individual end-users' perceptions of the usefulness of mobile ICT.	0.157	8.0208
H6d	The reported **accessibility of technology** will influence individual end-users' reported **business use** of mobile ICT.	0.151	2.2314
H9	**Perceived ease of use** of mobile ICT will positively affect the **perceived usefulness** of mobile ICT.	0.817	19.7115

Items are significant at the $P < 0.05$ level or $t > 1.96$.

value = 8.0208). Accessibility of mobile ICT also had a significant influence on business use of mobile ICT (*t*-value = 2.2314). Therefore, hypotheses H4a, H5c, H5d, H6a, H6b and H6d were supported (Table 4).

On the other hand, age, gender and education level had no effect on mobile ICT use or on the perceptions of use of mobile ICTs. Therefore, hypotheses H1a, H1b, H1c, H2a, H2b, H2c, H3a, H3b, and H3c were not supported. Likewise, H4b, H4c, H5a, H5b, H6c, H7 and H8 were not supported.

OBSERVATIONS AND IMPLICATIONS

Key observations

The study results prompt several key observations and hold important implications for global IT research, the digital divide and the development of m-commerce in sub-Saharan Africa.

Access to mobile ICT had a significant relationship with an individual's perceptions about mobile ICTs and explained a large portion of the variances of both Perceived Ease of Use and Perceived Usefulness. This shows that improving and simplifying the mechanisms by which end-users access mobile ICT could be key to enhancing its use in this region. Sub-Saharan Africa has seen a rapid diffusion of mobile devices for three main reasons. Countries in this region are opening up and liberalizing their telecommunications sectors; consumers are dis-

satisfied with the inadequacy of fixed-line ICT; and wireless technology lends itself to rapid diffusion because of its simple and ubiquitous nature. Increased access is an important first step towards the development of a solid and feasible base for business transactions mediated by wireless technology.

One approach to enable broader access to mobile ICTs is through the prepaid mobile-phone concept. For example, the east African country of Uganda epitomizes the revolution created by prepaid mobile in sub-Saharan Africa (ITU, 2002). While most Ugandans do not meet the financial criteria for subscription-based service, prepaid brought communication to the masses. Uganda's overall mobile telephone density quadrupled between 1998 and 2001, rising from 0.41 telephone subscriber per 100 people to 1.72. Over 50% of the population has mobile coverage, and more than 80 towns and rural areas have service. Not untypical, about 98% of Uganda's mobile subscribers are prepaid.

The average cost of a 3-minute mobile-to-mobile[1] phone call in sub-Saharan Africa is $0.57, while monthly subscription charges are $13.20 per month (See Appendix 1). Although the option for monthly subscription contracts is available, more than 90% of customers use prepaid phone cards. Prepaid service has allowed millions of users who would not normally financially qualify for subscription-based service to become mobile users.

Access to mobile ICT had a significant influence on the business use of mobile ICT, but not on the socializing use of these technologies. This finding was surprising as it is important. It indicates that not only does increased access leads to favourable perceptions about mobile ICT, but that the business use of these technologies is also largely dependent on its being accessible to the consumers. There has been a rapid diffusion of mobile ICT in sub-Saharan Africa (ITU, 2002; Mbarika *et al*., 2002a; UNCTAD, 2002). The finding that accessibility of mobile ICT is strongly associated with business use of these technologies indicates promise for the region. As the diffusion rates exceed the critical mass, we may begin to see an increase in value-adding business services that make use of mobile ICT, thereby marking the advent of a sustainable m-commerce sector. However, another inference from this finding is that a quantitative diffusion of mobile ICT may not be a sufficient precondition for seeding and developing an m-commerce sector, especially within the context of sub-Saharan Africa. Rather, there may be a need for efforts to ensure that these technologies are accessible to the vast majority of individuals through such actions as affordable pricing (Jara-Diaz, 1999), expansive geographical coverage by mobile ICT providers, localization of mobile ICT-based services and creation of awareness on how these technologies can be used for business or income generation (Meso & Duncan, 2000; UNCTAD, 2002). We provide some examples of innovative approaches to leveraging accessibility of mobile ICT and their business use in the implications section.

The perceptions of end-users about the reliability of mobile ICT have a significant influence on both the socializing and business use of mobile ICT and explain a good portion of these constructs' variances. This may be due to the reputation for poor and unreliable service that individuals have come to expect from the monopolistic ICT service providers of the past three

[1]The cost of making a mobile-to-fixed phone call is about two to three times the cost making a mobile-to-mobile phone call.

to four decades. It may also be due to the market-driven diffusion approaches prevalent among the mobile ICT service providers that have caused the sales of mobile phones and similar end-user ICT devices to far outpace the growth rate of requisite backbone infrastructure, especially in the remote and rural areas of these countries. Consequently, many consumers have a mobile ICT device that they can use only in several locations within their countries. Users may perceive this handicap as a reflection of the low reliability of mobile ICT in general. For example, two respondents made the following comments:

> The rate of our power supply [electricity supply] should be improved because the use of technology needs a constant power supply.

> . . . procure **functional**, **easy to maintain**, and **easily adaptable** technologies to the environment and the needs of the local people [emphasis ours].

Thus, improving actual reliability of mobile ICT and end-user perceptions of mobile ICT reliability is an important step towards the development of a solid and feasible base for successful development of m-commerce initiatives in these countries.

Implications

Before presenting the implications of this study, we want to caution that sub-Saharan Africa is still far from realizing the full potential of mobile ICTs. Although mobile phones are the main mobile ICT devices used in sub-Saharan Africa, the types of applications are as yet not complex and robust as in the developed economies. Rather, they are mainly used for voice communications. However, there is a growing use of these devices for short messaging services (SMS) as the main means for business communications for proprietors of small business enterprises and as microenterprise assets where rural and low-income urban entrepreneurs sell airtime on their phones to locals for economic sustenance. There is an increasing number of kiosks that sell prepaid phone cards, hence providing employment to the local populace. The use of mobile phones as microenterprise assets and the pay-as-you use (prepaid phone cards) models, although not unique to developing countries, are some significant ways in which mobile phone usage in these regions differs from how they are used in the advanced economies. Because of the scarcity of resources in the region, another key difference is the high levels of telephone sharing, where members of the same household or several different households share the same handset and contribute to the cost of purchasing the requisite prepaid calling cards. A corollary to mobile phone sharing is the use of mobile phones predominantly for receiving incoming calls and not for initiating calls. This is because subscribers do not pay for incoming calls, unlike the practice in some advanced economies such as the United States.

These issues notwithstanding, there has been a meteoric growth in mobile phone density across the least developed countries, and the economic applications of mobile phones presented earlier are indicative of an emerging commercial sector based on mobile ICTs. There-

fore, we see the meteoric growth in mobile phone density as a first step in the development of m-commerce and other more robust capabilities and markets. We discuss more specific implications below:

Implications for global IT research

Our results strongly suggest that any global IT study that assesses ICT impact should include the TAM and related theories. Industrial strategies to initiate and grow m-commerce operations in developing regions such as sub-Saharan Africa must include not only incentives that accelerate the quantitative diffusion of the devices but also those that address the equitable distribution of these technologies so that every potential customer is brought into the user network. Adoption strategies should also include ways to enhance users' perceptions of the technology's ease of use and usefulness. This may entail intensive education; promotion and even acculturation campaigns aimed at selling both the technology and desirable ways to use it. Finally, such strategies must also consider the technology's reliability. Poor perceptions of reliability are not only hard to change, but they also tend to create barriers to the use of related technologies that would help socio-economic development. A suggested effective approach to enhancing user perceptions about the reliability of mobile ICT is to build reliability into existing and future mobile ICT infrastructure as these developing countries expand their national information infrastructures.

Implications for the digital divide

Traditionally, the digital divide has been a poverty-centric problem. As the findings of this study indicate, perhaps the digital divide is also an access- and perception-centric problem. Perceptions of mobile ICT's reliability, and constraints that limit access to mobile ICT, seem to be marginalizing some end-users from enjoying the benefits of ICT. Where access is readily available and where ICT perceptions are positive, ICT use may be maximized, regardless of education, gender, culture or age, and the digital divide reduced.

Implications for m-commerce in sub-Saharan Africa

The growing convergence of the internet and mobile communications means that mobile ICT devices are increasingly becoming an integral part of an electronic and computer-mediated business infrastructure (Mbarika *et al*., 2002a; UNCTAD, 2002). For many people in developing countries, mobile handsets may be the first and main means of accessing information and communication applications, such as the internet and e-commerce (Mbarika *et al*., 2002a; UNCTAD, 2002). For example, many countries use Short Message Service (SMS) to deliver commercial messages to mobile-phone users. While most handsets do not have internet access, they support commercial SMS, which is being used effectively to promote the sale of goods or services whether or not it invites or solicits a response from a recipient. Given that

mobile phones outnumber personal computers, they become a logical channel for m-commerce in developing countries (Minges, 1999).

This meteoric increase in mobile ICT calls for an investigation of their potential. One aspect of this potential is their ability to spur both social and economic development. Literature on IT and technology development suggests that high levels of ICT impact the scope and depth of economic activity and engagement, economic productivity, standards of living, access to social development variables such as education and healthcare, and good governance, among others (Ives & Jarvenpaa, 1991; Meso & Duncan, 2000; ITU, 2002; UNCTAD, 2002; Rose *et al*., 2003). As the United Nations Commission for Trade and Development (UNCTAD) stated in 2002, 'mobile communications may be the technology that overcomes the barriers constituted by the high cost of installing fixed-line infrastructure that developing countries continue to encounter' (UNCTAD, 2002).

ICT is especially viewed as having a direct impact on the nature and productivity of a nation's business sector. UNCTAD (UNCTAD, 2002) reported that, 'The introduction of wireless communications has not only expanded telephony in many developing countries, but also introduced wireless data services which are essential for conducting m-commerce'. We concur with this perspective and view the diffusion of mobile phones as being a first step in the diffusion of m-commerce. As consumers become comfortable with using mobile phones as tools for business, they will find it increasingly easier to appreciate and therefore adopt portable computing devices, which are the base connection points for m-commerce, and integrate these into their business practices. In a region where electricity, water, railroads, airlines and so on are generally government owned and operated, m-commerce could serve as a vessel for improving the quality of life of its 770 million inhabitants.

Venue for business transactions

M-commerce can provide the avenue for transacting business and providing value-added services despite infrastructure limitations. For example, m-commerce can work with mobile phones that support the Wireless Application Protocol (WAP) (Mahlaba & Takawira, 2003). Netcover, a South Africa-based leading insurance provider, gives clients accurate insurance quotes over their WAP-enabled mobile phones, which let them get coverage immediately. More than 300 000 South Africans have access to a WAP-enabled mobile phone (Troskie, 2000). Netcover has been live for more than 3 years. Recently, Netcover has used these WAP-enabled devices to target new markets. The company now works with car dealers to underwrite and provide multiple insurance quotes using a WAP-enabled mobile phone (Troskie, 2000).

Another example of mobile ICT as a business venue is the exponential growth in prepaid billing. We believe that prepaid solutions operate ideally in cash-based economies (as opposed to credit), because customers do not always have fixed addresses or bank accounts against which a direct debit could be set up (Hamilton, 2001). Our research, coupled with an understanding of sub-Saharan Africa's economies, could help both foreign and local entrepreneurs better navigate the region's digital businesses.

LIMITATIONS AND FUTURE RESEARCH

This study remains limited in a number of ways. First, the study used mobile phones as surrogates for mobile ICT. As the diffusion of other mobile ICTs such as hand-held computing devices and laptop computers increases within the region, a comprehensive study that includes all types of mobile ICT devices that provides a comparative analysis of their impacts on mobile-commerce would enrich our understanding of the contributions of mobile ICT to m-commerce and uniqueness of m-commerce in LDCs in general, and sub-Saharan Africa in particular. Therefore, we plan to study the actual ways that individuals, microenterprises and regular business organizations select to use mobile ICT as these kinds of infrastructure become commonplace within the region and to examine how mobile ICT use differ from mobile ICT use in the advanced economies.

Second, the survey was conducted in only two countries within a vast geographic region. The two countries surveyed in the current study belong to the sub-Saharan Africa region of the LDCs. Extending this survey to LDCs in other regions such as South America, the Caribbean and Asia may provide a sharper understanding of the way hypothesized factors influence mobile ICT use and the implications for m-commerce.

Third, the methodology used – survey-based research – being heavily quantitative has its own limitations. It provides a broad-based perspective of the questions under investigation, but may not be the best approach to obtaining a detailed understanding of these questions. Additional studies that use more qualitative approached such as field study or case study methods conducted in the region may contribute to achieving a deeper understanding of the factors that influence mobile ICT use, and how the use of these technologies influences the diffusion of m-commerce. These limitations notwithstanding, the findings of this research are encouraging.

CONCLUSION

Many governments are actively seeking to narrow the digital divide and extend the considerable benefits of technology to developing nations. Given that sub-Saharan Africa comprises 33 of the 48 poorest countries in the world (Meso & Duncan, 2000; Mbarika *et al*., 2002a; UNCTAD, 2002), its growing mobile ICT use is one of the critical precursors to its socio-economic development. Our research then is really a genesis, as it helps us begin to grasp the adoption and diffusion issues related to m-commerce in sub-Saharan Africa. It may be that attaining effective m-commerce diffusion and use depends not simply on the abundance of mobile ICT, but on easier and preferably more affordable access, and the need to change perceptions of the technology's reliability as well as ensuring that the technology is indeed as reliable as possible.

In addition to the traditional TAM factors of usefulness and ease of use, greater reliability of the technology and easier access to the same by end-users contribute significantly towards greater confidence and hence greater use of mobile ICTs. As m-commerce success partly

depends on people using mobile ICT, working towards improving end-user perceptions of reliability and access, as well as providing easier access, should contribute to the growth of mobile commerce within the region.

The message to firms conducting business in the developing countries is clear: Pay attention to the factors that explain individual mobile ICT use because these factors will most likely determine the optimal market segmentation, business development and customer service strategies for leveraging m-commerce operations in that region. For government units, the understanding of such factors would also be beneficial in aiding economic planning and commerce.

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APPENDIX 1: AFRICA'S FIXED AND MOBILE TELECOMMUNICATIONS INDICATORS

		Main telephone lines		Mobile subscribers		Total density	Cost of cellular services (US$)		
Country	Population	Total	per 100 inhabitants	Total	per 100 inhabitants	per 100 inhabitants	3-minute call	Monthly subscription	Connection charge
Algeria	30,836,000	1,880,000	6.10	100,000	0.32	6.42	0.13	16.84	259.02
Egypt	64,550,000	6,688,367	10.36	2,793,800	4.33	14.69	0.68	16.37	125.94
Libya	5,580,000	610,000	10.93	50,000	0.90	11.83	N/A	N/A	N/A
Morocco	30,430,000	1,191,335	3.92	4,771,739	15.68	19.60	0.53	11.06	8.85
Tunisia	9,700,000	1,056,209	10.89	389,208	4.01	14.90	0.17	***16.81***	***100.84***
North Africa	**141,096,000**	**11,425,911**	**8.10**	**8,104,747**	**5.74**	**13.84**	**0.38**	**15.27**	**123.66**
South Africa	**43,792,000**	**4,924,458**	**11.25**	**11,029,744**	**25.19**	**36.43**	**0.56**	**20.33**	**11.03**
Angola	13,528,000	80,000	0.59	86,500	0.64	1.23	*0.24*	*29.88*	*89.64*
Benin	6,446,000	59,298	0.92	125,000	1.94	2.86	*1.01*	*14.05*	***6.73***
Botswana	1,680,863	*150,300*	*8.94*	278,000	16.54	*25.48*	0.67	14.55	14.55
Burkina Faso	11,667,771	57,619	0.49	75,000	0.64	1.14	0.72	8.05	56.34
Burundi	6,860,000	20,000	0.29	20,000	0.29	0.58	N/A	N/A	N/A
Cameroon	15,203,000	101,442	0.67	310,000	2.04	2.71	N/A	N/A	N/A
Cape Verde	437,000	62,342	14.27	31,507	7.21	21.48	0.61	24.35	32.83
Central African Republic	3,782,000	10,000	0.26	11,000	0.29	0.56	***0.58***	***0.00***	***227.38***
Chad	7,664,827	11,000	0.14	22,000	0.29	0.43	N/A	N/A	3.41
Comoros	727,000	8,856	1.22	0	0.00	1.22	N/A	N/A	N/A
Congo	3,111,000	22,000	0.71	150,000	4.82	5.53	N/A	N/A	N/A
Congo (D.R.)	52,522,000	20,000	0.04	150,000	0.29	0.32	N/A	N/A	N/A
Cote d'Ivoire	16,348,000	293,568	1.80	728,545	4.46	6.25	0.68	19.10	27.28
Djibouti	643,000	9,932	1.54	3,000	0.47	2.01	*0.59*	*16.88*	*281.34*
Equatorial Guinea	470,000	6,900	1.47	15,000	3.19	4.66	N/A	N/A	N/A
Eritrea	3,816,000	31,249	0.82	0	0.00	0.82	0.00	0.00	0.00
Ethiopia	65,390,000	283,683	0.43	27,500	0.04	0.48	0.26	5.91	99.34
Gabon	1,262,000	37,233	2.95	258,087	20.45	23.40	N/A	N/A	N/A
Gambia	1,337,000	35,029	2.62	55,085	4.12	6.74	0.67	15.97	19.17
Ghana	20,930,000	242,122	1.16	193,773	0.93	2.08	0.67	7.42	37.10
Guinea	8,020,000	25,490	0.32	55,670	0.69	1.01	*0.26*	***15.14***	*67.55*
Guinea-Bissau	1,227,000	12,000	0.98	0	0.00	0.98	N/A	N/A	N/A
Kenya	31,293,000	326,282	1.04	600,000	1.92	2.96	0.57	6.36	31.82
Lesotho	2,160,000	*22,200*	*1.03*	33,000	1.53	*2.56*	***0.62***	***16.37***	11.61
Liberia	3,108,000	6,800	0.22	2,000	0.06	0.28	N/A	N/A	N/A
Madagascar	16,437,000	58,399	0.36	147,500	0.90	1.25	*0.78*	*7.31*	*22.16*
Malawi	10,385,849	54,107	0.52	55,730	0.54	1.06	0.78	0.00	23.55
Mali	11,678,000	49,863	0.43	45,340	0.39	0.82	*1.26*	*8.43*	*82.87*
Mauritania	2,747,000	*18,969*	*0.69*	*7,133*	*0.26*	*0.95*	N/A	N/A	N/A
Mauritius	1,191,900	306,773	25.74	300,000	25.17	50.91	0.10	4.29	17.16
Mayotte	143,295	10,000	6.98	0	0.00	6.98	N/A	N/A	N/A
Mozambique	20,190,000	89,444	0.44	169,900	0.84	1.28	*0.45*	*14.63*	*25.89*
Namibia	1,788,000	117,398	6.57	100,000	5.59	12.16	0.40	12.20	29.04
Niger	11,227,000	21,659	0.19	1,848	0.02	0.21	*0.23*	*7.90*	*42.14*
Nigeria	116,929,000	540,518	0.46	500,000	0.43	0.89	1.08	44.95	98.89
Reunion	731,000	300,000	41.04	421,100	57.61	98.65	***1.22***	***31.60***	***62.12***
Rwanda	7,949,000	21,500	0.27	65,000	0.82	1.09	N/A	N/A	N/A
Sao Tome & Principe	150,000	5,441	3.63	0	0.00	3.63	N/A	N/A	N/A
Senegal	9,662,000	237,160	2.45	390,800	4.04	6.50	*0.56*	*9.36*	*44.95*
Seychelles	81,900	21,382	26.11	44,116	53.87	79.97	0.49	16.89	85.15
Sierra Leone	4,870,000	22,745	0.47	26,895	0.55	1.02	N/A	N/A	N/A
Somalia	10,050,000	*35,000*	*0.35*	N/A	N/A	N/A	N/A	N/A	N/A
Sudan	31,809,000	453,000	1.42	105,000	0.33	1.75	0.14	11.62	193.75
Swaziland	1,020,000	32,000	3.14	66,000	6.47	9.61	0.38	5.81	11.03
Tanzania	35,965,000	148,464	0.41	426,964	1.19	1.60	0.82	*24.91*	18.27
Togo	4,657,000	48,084	1.03	95,000	2.04	3.07	*0.75*	*6.32*	*27.39*
Uganda	22,525,924	63,741	0.28	322,739	1.43	1.72	*0.36*	*21.16*	*27.36*
Zambia	10,649,000	85,662	0.80	121,200	1.14	1.94	0.58	8.31	0.00
Zimbabwe	13,650,000	253,738	1.86	328,669	2.41	4.27	0.40	5.99	7.27
Sub-Saharan Africa	**626,120,329**	**4,930,392**	**0.79**	**6,971,601**	**1.13**	**1.92**	**0.57**	**13.20**	**53.68**
Africa	**811,008,329**	**21,280,761**	**2.62**	**26,106,092**	**3.26**	**5.88**	**0.55**	**13.61**	**59.76**
Data year:	2001	*2000*	***1999***						

Source: International Telecommunications Union World Database, 2002.

APPENDIX 2: THE WORLD'S 48 LEAST DEVELOPED COUNTRIES

	Africa	Asia and Pacific	Americas	Middle East	Year of entry to list
Afghanistan		X			1971
Angola	X				1998
Bangladesh		X			1975
Benin	X				1971
Bhutan		X			1971
Burkina Faso	X				1971
Burundi	X				1971
Cambodia		X			1991
Cape Verde	X				1977
Central African Republic	X				1975
Chad	X				1971
Comoros	X				1977
Congo D. R.	X				1991
Djibouti	X				1982
Equatorial Guinea	X				1982
Eritrea	X				1998
Ethiopia	X				1971
Gambia	X				1975
Guinea	X				1971
Guinea Bissau	X				1981
Haiti			X		1971
Kiribati		X			1986
Lao (PDR)		X			1971
Lesotho	X				1971
Liberia	X				1990
Madagascar	X				1991
Malawi	X				1971
Maldives		X			1971
Mali	X				1971
Mauritania	X				1986
Mozambique	X				1988
Myanmar		X			1987
Nepal		X			1971
Niger	X				1971
Rwanda	X				1971
Samoa		X			1971
Sao Tome & Principe	X				1982
Senegal	X				?
Sierra Leone	X				1982
Solomon Islands		X			1991
Somalia	X				1971
Sudan	X				1971
Tanzania	X				1971
Togo	X				1982
Tuvalu		X			1986
Uganda	X				1971
Vanuatu		X			1985
Yemen				X	1971
Total (48)	33	13	1	1	

Source: OHRLLS, 2004 (http://www.un.org/special-rep/ohrlls/ldc/default,htm)

APPENDIX 3: OPERATIONALIZATION OF LATENT VARIABLES

Latent Variable	**Indicator**	
	No	**Syntax of Question on Instrument**
Age	1	Age: _____
Gender	2	Gender: 1: Male ____, 2: Female ____
Education Level	3	Highest Level of Education Obtained (please select one) 1: No formal schooling, 2: Primary School Certificate, 3: High School Certificate, 4: Bachelors degree or equivalent, 5: Masters degree or equivalent, 6: PhD or equivalent
Perceived Usefulness	4	If you were to share with a subordinate an elaborate plan for a critical client presentation she is giving that afternoon, please rank you preference for using mobile ICT device such as a mobile-phone to communicate with the colleague, with '1' indicating most preferred and '10' indicating least preferred.
	5	Using a scale of 1 to 5, please indicate your feeling towards mobile ICTs such as mobile-phones.
Perceived Ease Of Use	6	Whenever you must bring a colleague up to date on a complicated or non-routine project you have been working on, what is you preference of using mobile ICTs such as mobile phones to communicate with the colleague, with '1' being most preferred and '10' being least preferred.
	7	If you want to send a low priority document or report that is available in machine readable form to a colleague across the country, please rank your choice of using mobile ICTs such as mobile-phones for this task, with '1' being most preferred and '10' being least preferred
	8	If you have to send a very urgent memo to all members of your department, please rank your choice of mobile ICTs such as a mobile-phone for communicating with the colleagues, with '1' being the most preferred and '10' being the least preferred
Perceived Reliability of Mobile ICT	9	If you own a mobile-phone How reliable is the service? 1: totally unreliable, 2: mostly unreliable, 3: reliable about half the time, 4: usually reliable, 5: very reliable
	10	How many times have you changed the service provider of your mobile-phone over the past five years? 1: one time, 2: twice, 3: three times, 4: four times, 5: five times or more
Access to Mobile ICT	11	Which of the following do you personally own? Select all that apply: regular telephone, fax machine, desk top computer, lap top computer, mobile-phone, other
	12	Which of the following do you readily have access to? Select all that apply: regular telephone, fax machine, desk top computer, lap top computer, mobile-phone, other
	13	Please indicate your level of easy access to mobile ICTs such as mobile phone technologies. 1: readily available, 2: available with slight convenience; 3: available with some inconvenience, 4: available with much inconvenience, 5: unavailable.
Cultural Influences	14	In your opinion, do tribal differences in your country affect the proliferation of technology negatively? 1: definitely, 2: to a large extent, 3: somewhat, 4: not really, 5: definitely not at all
	15	In your opinion, do religious differences in your country affect the proliferation of technology negatively? 1: definitely, 2: to a large extent, 3: somewhat, 4: not really, 5: definitely not at all
	16	Do you feel that the political structure of your country affect the proliferation of technology negatively? 1: definitely, 2: to a large extent, 3: somewhat, 4: not really, 5: definitely not at all
	17	In your opinion, does rapid technological advancement promote socio-economic development? 1: definitely, 2: to a large extent, 3: somewhat, 4: not really, 5: definitely not at all
Uses of Mobile ICT:	18	Please circle all the things you use mobile ICT such as mobile-phone for. 1:access bank account, 2: e-card transaction, 3: for business or work related e-mail, 4: to conduct business, 5: other
	19	Please circle all the things you use mobile ICT such as mobile-phone for. 1: to talk to friends and family members, 2: to email friends and family members, 3: to access cyber-cafes, 4: other