DRAFT

Texting among the Bottom of the Pyramid[1]: Facilitators and Barriers to SMS Use among the Low-income Mobile Users in Asia

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1. Introduction

Mobile communication has recently experienced an exponential growth in developing countries. The scope of mobile diffusion is unprecedented as no other media technology in history has reached such a wide population, even to the poor at the Bottom of the Pyramid (BOP) (Castelle et al. 2007; Prahalad 2004). The mobile phone is, in many cases, the first and the single modern technology *personally* owned by the poor. Although these new users in developing countries are often constrained in economic and social resources, their mobile use is increasing with falling prepaid prices (ITU, 2011) as well as expanding with the invention of new use behaviors such as 'beeping' on missed call signs (Donner, 2007) and phone-sharing (Sey, 2009).

This newly introduced connectivity at the BOP invites a hope that development intervention services can be delivered directly to the hands of the poor. Indeed, many development agencies and NGOs are exploring the potential of mobile phone as a cost-effective platform to carry development services such as education, healthcare, financial, agricultural programs. Spurred by the evidence of the mobile phone's positive impact on economic activities (Jensen, 2007; Abraham 2007; Aker, 2008), and the successful cases like mobile banking service in Kenya (Hughes and Lonie, 2007; Morawczynski, 2009), mobile phones are increasingly perceived as a smart catalyst to development. Numerous m-service projects (i.e. m-health, m-education, m-government, m-banking, m-agriculture, etc.) are currently in trial across the world (UNDP, 2012; IFC 2011; GSMA mWomen, 2012).

Short Messaging Services (SMS) is currently the most popular method employed by such m-services. Various reasons support its popularity. SMS is available on all mobile phones

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regardless of manufacturers or network systems. The technology is robust and reliable; it works well even in the rural areas with patchy coverage as SMS messages can be stored in the network's server and can be forwarded when the phone appears within a signal range (Fitzerald et al. 2010). Moreover, SMS can be easier and more cost-effective to disseminate information to a wide population when compared to a few-minute-long call, voice message or Interactive Voice Response (IVR) system.

Yet, SMS comes with limited communication possibilities and inconvenient usability. The small screen, cumbersome input method, limited contents (i.e. up to 160 alphanumeric Latin characters or 70 in non-Latin languages) and asynchronous communication can make the service less attractive, time-consuming and complicated to use. Despite these technical limitations, SMS was unexpectedly picked up by the youth in the developed world and later became an essential part of mobile communication even in the era of the smartphone (Taylor and Vincent, 2005; Ling, 2005).

It is, however, unclear whether the same path will be followed by users in developing countries. While the users in advanced countries were already familiar with telegraphs, pagers, and emails prior to SMS, mobile users in developing countries generally find SMS as their first text-based electronic communication tool. Indeed, countries vary in terms of the level of SMS adoption. Whereas SMS use is predominant in some countries like the Philippines and South Africa, East Africa and South Asia show a low penetration of SMS especially among the rural and poor communities (Rheingold, 2002; Hellstrom, 2010; Rashid & Elder, 2009; Frempong et al, 2007; GSMA mWomen, 2012; LIRNEasia, 2008). Although SMS-based development initiatives and their pilot projects are proliferating across developing countries, there is still a paucity of empirical studies looking closely on SMS adoption and usage in these regions, and in particular among the users with limited economic and social capabilities.

This paper investigates the adoption and use behaviors of SMS on mobile at the BOP. It asks three research questions: (1) *Who are the users and the non-users of SMS among the BOP mobile owners?* (2) *What are the barriers to SMS adoption?* and finally, (3) *What are the factors driving SMS use at the BOP?* Based on the multi-country survey data from LIRNEaisa Teleuse@BOP project in 2011, this paper presents two sets of analyses: first, a descriptive analysis is used to explore the user and non-user characteristics and their usage patterns. The paper then presents the second analysis using structural equation modeling (SEM) to examine the

SMS user's perceptions and decision-making process of SMS use. Based on its findings, the paper attempts to provide theoretically grounded empirical evidence on mobile use behaviors among the BOP, as well as drawing practical implications for the Information Communications Technology for Development (ICTD) practitioners providing SMS-based development services in the region.

2. Literature Review

SMS Adoption in Developed and Developing Countries

In its inception, SMS was designed for system maintenance or customer notifications and the early mobile operators also saw no strong business case to promote SMS to non-business users. Taylor and Vincent (2005) explain the reasons behind the unexpected uptake of SMS in terms of multiple innovations interwoven with technology, regulation, business and users. In its inception, GSM standardization and interconnection agreement allowed SMS to be ubiquitous and interoperable. Then, the industry came up with the pre-paid billing system that allowed more users to afford mobile phones. In addition, due to the lack of attention paid on SMS by the early operators, the SMS charge was inadvertently dropped in the initial pre-pay plan. Finally, teenagers, who were already familiar with instant messaging on PC, picked up this loophole of free SMS and created a new culture of avid texting. Ling (2005) also analyzes the user benefits of SMS as cheaper, ubiquitous, unobtrusive, and discreet. Nowadays, texting is increasingly dominant in mobile communication not only in teen culture but also among general users. A recent study reports that the median US teen text users send out 60 texts a day while their voice call frequency is on the decline (Pew Internet & American Life, 2012).

In developing countries, the interoperable standards and pre-paid billing plans are all in place but the user behavior utilizing mobile services beyond voice call is still scanty, in particular among the BOP mobile users. A 2008 survey from South Asian countries reports that around 30 percent of the BOP mobile owners in India and Bangladesh had *ever* sent or received SMS (LIRNEasia, 2008). Similarly, only 37 percent of the BOP women in four developing countries had sent SMS regardless of their literacy levels (GSMA mWomen, 2012). The level of user adoption was found to be low even in the case of SMS-based intervention services designed for the poor. Zainudeen & Ratnadiwakara (2011) point out that the awareness of the BOP users of

such information and banking services were less than 20 percent while their actual use was much lower. From an experiment of SMS-based healthcare service in rural Uganda, Chib et al. (2012) found that the response rate to such intervention was again as low as 20 percent despite participation incentives, and the effect on health knowledge was only limited. Intuitive answers to this low adoption of SMS can include cost barriers and illiteracy. However, these barriers have not yet been proven empirically while there can be further barriers or facilitators in the psychological and the social contexts of the BOP mobile users.

Theoretical Framework

In exploring the behavioral and the psychological motivations behind people's technology adoption, Technology Acceptance Model (TAM) is one of the most widely used theoretical frameworks. Grounded in Theory of Reasoned Action (TRA) (Ajzen & Fishbien, 1980), TAM assumes *behavior* is determined by one's *behavioral intention* to perform a target behavior, and this intention is influenced by the cognitive assessment of two key components of the target technology: *perceived usefulness* (PU) and *perceived ease of use* (PEOU) (Davis, 1989). The twenty-year long survival of TAM in the fast-moving information system (IS) research demonstrates its theoretical strength and benefits. Compared to other adoption theories, TAM is specifically tailored for the context of information technology and consistently outperforms other models in explanatory power in IS research (Hong et al, 2006; Taylor & Todd, 1995; Bagozzi, 2009; Yousafzai et al, 2010). It offers a parsimonious but powerful framework as well as a set of well-proven measurements that facilitate the accumulation of empirical findings.

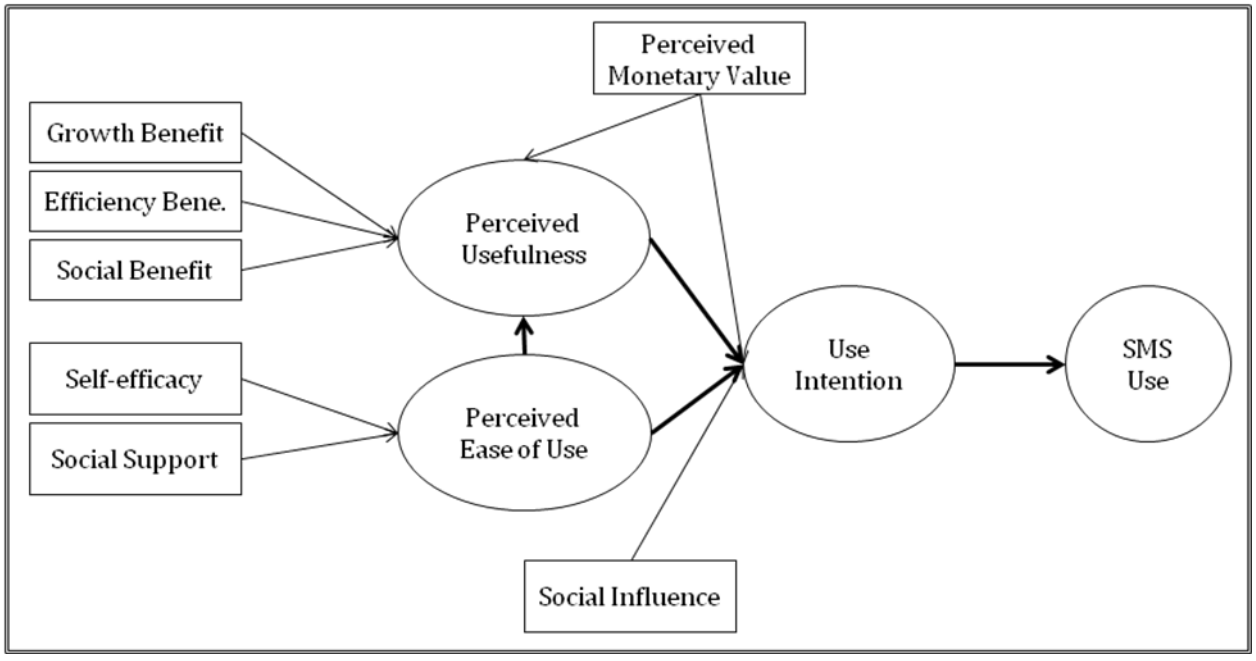
Nevertheless, TAM also has several limitations in terms of being applied to the context of developing countries. First, originally designed for organizational contexts where the access to technology and required training were granted, TAM fails to account for the constraints of the BOP mobile owners in relation to material resources, skills and experiences in technology use (Musa, 2006; Park et al, 2009). We suspect that these constrains may affect PEOU. Second, TAM does not pay much attention to '*what actually makes a system useful*' (Benbasat & Barki, 2007). Suggesting that people will adopt the technology if they find it useful does not provide any explanation other than commonsense understanding, and fails to deliver actionable implications to the ICTD practitioners. Third, the original TAM neglects the social aspect of technology adoption. Social influence is found to have salient effects on networked technologies

such as mobile services (Lopez-Nicolas et al, 2008, De Silva et al, 2011), while external assistance may facilitate adoption in developing countries (Park et al. 2009). In short, TAM is a good starting framework in understanding user's technology adoption but it is necessary to extend the model further in relation to the antecedents to PU and PEOU that help us understand the specific contexts of mobile use in developing countries.

3. Hypotheses and Model Development

Based on the theoretical framework of the TAM, this paper builds an extended model with five antecedents to *perceived usefulness* and *perceived ease of use* (See Figure 1). PU is explained with three perceived benefits of SMS on *personal economic growth*, *efficiency gains* and, *social benefits*, while PEOU is predicted by *self-efficacy* and *social support*. *Perceived Monetary Value* and *Social Influence* are hypothesized as additional predictors to *intention to use*.

Figure 1. Hypothesized Framework



Perceived Usefulness and Perceived Ease of Use

Perceived Usefulness (PU) is defined as 'the degree to which an individual believes that using a specific system will increase his or her performance' and *perceived ease of use* (PEOU) refers to 'the degree to which an individual believes that using a particular system would be free of efforts' (Davis, 1989). PU has proven to be a robust predictor of user's behavioral intention or actual use in extensive empirical studies (Davis et al, 1989; Venkatesh et al, 2003; Hong & Tam, 2006; Yousafzai et al, 2010). The findings on PEOU are less congruent as some studies find the effect of PEOU generally lower than PU or even insignificant (Wu & Wang, 2004). However, we assume that this is due to the enhanced usability and user experiences of technology in advanced countries, and that PEOU is still an essential predictor to SMS use in developing countries. Finally, according to the TAM and the TRA frameworks, intention to continue using the service leads to actual use. Previous studies also find that PU and PEOU are major factors influencing mobile service adoption (Nysveen, 2005; Hong & Tam, 2006) as well as SMS use (Kim et al, 2008; Zhang & Mao, 2008). Based on prior research, the following hypotheses proposed by the TAM framework are formed:

H1: Perceived usefulness is positively associated with the intention to use of SMS.
H2: Perceived ease of use is positively associated with the intention to use of SMS.
H3: Perceived ease of use is positively associated with perceived usefulness of SMS.
H4: The intention to use SMS is positively associated with the actual use of SMS.

Antecedents to PU: Perceived Benefits

TAM originally defines perceived usefulness relating solely to job performance at work. Since mobile phone is a multi-functional technology used in everyday communications, the definition of PU needs to be redefined with regard to the multi-dimensional nature of perceived benefits reaped by mobile users. Regarding the instrumental benefits of technology use, diffusion theory suggests a concept of '*relative advantage*', which is a broad notion capturing all possible instrumental benefits, but does not provide much insight on what advantages mobile phones might deliver. Uses and Gratification (U&G) theory explains different motivations explaining media use, such as information, entertainment, interpersonal relations (inclusion, affection, control etc.), convenience, and so forth (Ruggiero, 2000; Rubin, 1993; Lin, 2002). However, these motivations are grounded mainly in the study of televisions or the internet in advanced countries.

Acknowledging the limitations of the previous frameworks in explaining the BOP mobile phone users in developing countries, this study proposes a new conceptualization of the instrumental benefits of mobile use: *growth, efficiency*, and *social* benefits. *Perceived growth benefit* refers to the ability to expand one's own resources by accessing information, work opportunities, financial means, and so forth. It indicates not only the information gains but also the economic gains realized by such information. It also includes the enhanced social communication with financial sources such as banks, money lenders, employers or buyers, which can facilitate one's economic growth. The concept can include information, economic, social realms of mobile communication, but ultimately focuses on the expansion of one's resources regardless of the types of activities. Several studies in the ICTD literature suggest the impact of mobile phones on economic gains via market price information (Jensen, 2007; Aker, 2008). Using mobile phones is also found to have positive impact on business growth of female micro-entrepreneurs (Chew et al. 2010).

Perceived efficiency benefit refers to the ability to manage one's resources in a way so as to increase the level of efficiency in life. This includes saving money and time by reducing travels or transactional cost. It focuses on the efficient management of the existing resources through mobile phones instead of gaining new resources. Abraham (2007) found that mobile phones increased the efficiency of Indian fishermen by allowing them to coordinate their catch with demand, by helping them in finding the underserved markets, and by reducing their time idling at sea. Boateng (2011) also suggests that mobile phones enable Ghanaian traders to monitor and schedule their sales activities more efficiently. Not limited to economic activities, we assume that mobile phones and SMS introduce an enhanced capability to coordinate one's everyday activities in quicker, cheaper, and better-organized ways.

Perceived social benefit refers to the ability to improve one's social relationships with friends and family with enhanced communication on mobile phones. Studies suggest that mobile phones in developing countries are used mainly for reaching out to personal contacts than for business-related purposes, even among the micro-entrepreneurs (Donner, 2004; Rashid & Elder, 2009, De Silva et al, 2011). We assume that mobile phones enhance the ability to maintain social relations by introducing frequent and immediate communications over mobile phones and SMS. Therefore, the following hypotheses are formed:

H5: Higher perceived growth benefit leads to higher perceived usefulness

H6: Higher perceived efficiency benefit leads to higher perceived usefulness
H7: Higher social benefit leads to higher perceived usefulness

Antecedents to PEOU: Self-Efficacy and Social Support

***Self-efficacy*:** In the absence of a comprehensive set of objective measures of the user's skills and potential resources, self-efficacy can be one of the most accurate constructs reflecting people's capabilities required to use a target technology. Self-efficacy is defined as 'one's belief in his or her capability to organize and execute a particular course of action' (Bandura, 1997; Compeau & Higgins, 1995). The construct is distinct from self-confidence or self-esteem. According to Bandura, this personal evaluation on capability is a dynamic reflection of one's own biological, social and structural condition, and is constantly re-estimated and adjusted through direct and indirect experiences. In this study, self-efficacy is conceptualized as a reflection of one's skills, resources (i.e. time) and facilitating conditions to use SMS. Previous studies found that self-efficacy is a positive predictor of PEOU in computer use (Venkatesh & Davis, 1996; Venkatesh, 2000), mobile banking (Luarn & Lin, 2005) and SMS advertizing among the Chinese youth (Zhang & Mao, 2008). Thus the study hypothesizes:

H8: *Higher Mobile Self-efficacy is positively related to greater perceived ease of use of SMS.*

***Social Support*:** Availability of technical assistance is one of the important facilitating conditions in technology use (Ventakesh et al, 2003; Park et al, 2008). In the context of mobile use in developing countries, studies found that technical assistance often occurs in social settings, typically through help from family members or friends (LINREasia, 2009). Therefore, the BOP users who lack skills and literacy are likely to be more comfortable with SMS if they have assistance from the members of their family or friends who can type or read out messages to them, or know how to resolve technical problems. Social support has also been suggested as one of the dimensions of the digital divide in the internet use at home (DiMaagio et al, 2001). In developing countries, technical assistance from the service providers also tends to take place through social interactions in local shops or top-up kiosks rather than through help-lines or websites. The presence of these social support systems is distinctive social influence, and we hypothesize that:

H9: *Higher level of social supports leads to higher level of perceived ease of use.*

Social Influence

While TAM implicitly assumes that individuals are rational and independent agents who evaluate their personal utility gains pertaining to technology use, others argue that technology use is influenced substantially by social dynamics or even constructed in social contexts (Markus, 1990; Fulk et al., 1993). Although the original TAM omitted 'social norms' from TRA due to '*weak theoretical foundations*' (Davis et al, 1989), social influence was later acknowledged as a key predictor of the adoption in the succeeding versions of TAM (Venkatesh & Davis, 2000; Venkatesh et al, 2003). Several studies also found social influence as direct predictor of use intention in mobile services (Nysveen, 2005; Hong & Tam, 2006; De Silva et al, 2011) and SMS adoption (Kim et al, 2008; Lu et al, 2010).

In fact, social influence is often confounded with other similar constructs such as *subjective norms, perceived critical mass,* and *perceived network externalities* (Cho, 2012). In this study, social influence is defined as 'the degree to which an individual perceives that important others believe he or she should use the new system' (Venkatesh & Davis, 2000). We chose a relatively narrow definition of social influence so as to capture the sense of perceived pressure from the people who are influential in proximity within everyday interactions (i.e. family, peer, community, opinion leaders). We assume that the effect of critical mass or network externalities of SMS is currently less salient in developing countries as the adoption rate is less than the majority while the social norms vary significantly between cultures, countries, and regions (urban/rural). Therefore, the study forms the following hypothesis:

H10: *Higher social influence is positively associated with greater intention to use SMS.*

Perceived Monetary Value

For the poor who are often defined as people living under USD2 a day, the cost of mobile and SMS service is expected to play a more important role than for the affluent consumers. If SMS is priced too high, the BOP users may limit or avoid usage. On the other hand, if SMS is considerably cheaper than voice call, it may facilitate the adoption and use, although the substitution effects were found to be only marginal in advanced countries (Kim, et al. 2009).

To estimate the effect of 'cost', it is more accurate to use subjective measures such as 'perceived cost', often measured by the degree of expensiveness the user perceives, as one can reflect on one's own resources in being able to afford the service. However, cost is a multi-

dimensional construct because it not only depends on one's available budget, but also on whether the value obtained is commensurate with the cost incurred (Dodds et al, 1991). In other words, people may perceive the price to be slightly higher than their expectation but decide to use the service if it offers value to them, or vice versa. Therefore, we suggest 'perceived monetary value (PMV)' or, in order words, 'value for money' as a more comprehensive measure than 'perceived cost'. In this study, PMV is defined as 'the degree to which individuals perceive the appropriateness of the cost in relation to one's perceived benefits and preference of the service'. Previous studies also found PMV to be significant in predicting technology use (Kim et al, 2008; Hong & Tam, 2006). Since its concept is closely linked with the perceived utility, PMV is found to affect the PU (Kim et al, 2008). Based on our reasoning and previous studies, we hypothesize the following:

H11: *Higher perceived monetary value leads to greater intention to use SMS.*

H12: *Higher perceived monetary value leads to greater perceived usefulness of SMS.*

4. Data and Methods

Data Collection

This investigation uses data collected via the fourth round of survey conducted in 2011 as part of LIRNEasia's Teleuse@BOP project[2]. The survey comprises 9,066 respondents of the 'BOP telesuers' from Bangladesh, Pakistan, India, Sri Lanka and Thailand. The 'BOP' (Bottom of the Pyramid) is defined as the two lowest strata of socioeconomic classifications (SEC)[3]. 'Teleusers' is defined as those who are between ages 15 and 60, and have accessed, not necessarily owned, telephony services in the last three months including fixed-line, mobile and public phone services.

The study used a multi-stage stratified cluster sampling by Probability Proportionate to Size (PPS). It covered all provinces of each country except India where the majority of states were covered. The sampling plan selected the target number of urban and rural centers in each province using PPS. Within the selected centers, a well-known place such as a road, park or

[2] The data collection was carried out by a market research firm with industry reputation and experience in May to June in 2011.

[3] As commonly used in market research, SEC is based on the level of education and occupational status of the chief wage earner of the household.

hospital was assigned as the starting point for contacting households for the survey using the right-hand or the left-hand rule[4]. The number of starting points in each center was assigned in terms of the proportion to the population, and then a fixed number of interviews were conducted per starting point[5]. The structured survey questionnaire was first created in English and then translated to local languages. Back-translation and pre-tests were conducted to modify any obscure questions and words. The survey was conducted face-to-face by sufficiently trained administrators who read out each question and marked the answers on behalf of the respondents. A set of pictorial or text card was used for Likert-scale or complex questions.

Sample Size and Measurement Items

The study focuses on mobile phone owners only. Of the total 9,066 respondents, 54.3 percent own a personal mobile phone (N=4926). The BOP mobile owners are predominately on pre-paid plans (98.4%) and have been using mobile phones for an average of 3.5 years (SD=33.3). The mean age of the mobile owners is 32.8 years and 42.7 percent are female. SMS users were defined as those who have ever used SMS on their phones, including both sending and receiving messages, to communicate with people or to access information or payment services. Approximately thirty two percent (32.2%) of the mobile owners have ever used SMS, which yields to the sample size of 1,585. Demographic differences between the SMS users and non-users are analyzed in the following section.

For those who used SMS, the set of measures based on our theoretical model was asked to examine their underlying motivations. Only valid responses to users' perceptions of usage regarding SMS can be included in the analysis. Therefore, cleaning the data yields a subset of 989 responses. The study adopts the measures that have been previously tested and commonly used in existing literature with the particular intention to facilitate a comparison between the accumulated findings mostly from developed countries and our findings from an under-researched population. In particular, this study uses validated measures on *perceived usefulness*, *perceived ease of use*, *social influence*, *perceived monetary value*, *self-efficacy* and *social support*. *Intention* measures are directed to the continued usage in the future while actual *use* captures the frequency of SMS sent or received on a typical week. The list of the items for

[4] One respondent per household was selected; the Kish grid was used to randomly select respondent in households with more than one eligible respondents.

[5] In urban areas, three houses were skipped to minimize the neighborhood bias. For more details on the sampling methods, see De Silva et al. (2008, 2011).

constructs and their sources are stated in Table 1. All items are measured on a five point scale, ranging from strongly disagree (1) to strongly agree (5) or no change (1) to improved greatly (5).

Table 1. Measurement Items

Construct		Items	Sources
Perceived Usefulness [a]	PU1	I find SMS to be useful in my life	Davis (1989)
	PU2	Using SMS increases my chances of achieving things that are important to me	Kim et al. (2008)
	PU3	Using SMS helps me accomplish things more quickly	
	PU4	I find SMS gives me useful information	
Perceived Ease of Use [a]	PEOU1	I find SMS to be easy to use	Davis (1989)
	PEOU2	I think learning how to use SMS is easy to me	
	PEOU3	My interaction with SMS is clear and understandable	
Social Influence [a]	SI1	People who influence my behavior think I should use SMS	Venkatesh et al. (2003)
	SI2	I use SMS because I want to use the same service as people around me	Kim et al. (2008)
	SI3	I use SMS because it is common to use it in my community	
Perceived Monetary Value [a]	PMV1	I think SMS is reasonably priced	Kim et al. (2008)
	PMV2	I think SMS offers values for money	
Self-Efficacy [a]	SE1	I am confident of using SMS if someone showed me how to do it first	Compeau& Higgins (1995)
	SE2	I am confident of using SMS if I could ask someone for help if I got stuck	
	SE3	I am confident of using SMS if I had a lot of time to try and use the service	
Social Support [a]	SS1	When I have problems in using SMS, I can get help from my friends/family members	Venkatesh et al. (2003)
	SS2	When I have problems in using SMS, I can get help from the service providers or experts	Teo&Pok, (2003)
Perceived Growth Benefits [b]	G1	Improved my ability to make more money	LIRNEasia
	G2	Improved my ability to find out about employment/work opportunities	
	G3	Improved my access to information I need in my job	
	G4	Improved my access to finance	
Perceived Efficiency Benefits [b]	E1	Improved my ability to reduce travel	LIRNEasia
	E2	Improved my ability to act or contact others in an emergency	
	E3	Improved my efficiency of your day to day work	
	E4	Improved my relationships with family and friends	
Intention [a]	IU1	I intend to use SMS in future.	Davis (1989)
	IU2	I expect that I would use SMS frequently in future.	
Use [c]	USE	Frequency of sending SMS on a typical week	LIRNEasia

Five-point Likert scales:
[a]1= Strongly Disagree; 5=Strongly Agree
[b]1=No Change; 5=Greatly Improve
[c]1=Less frequent than once a week, 5=Several times a day

5. Analysis

(1) Descriptive Statistics: *SMS users vs. Non-Users*

Prior to testing our model with the SMS users, we first explored the different characteristics between SMS users and SMS non-users. The cross-tabulation results with chi-square differences are reported in Table 2. Overall, the SMS users tend to be younger, single,

urban residents with higher income and more education than the non-users. On the other hand, the gender difference was not found to be statistically significant for SMS use.

The mean age of the SMS users is 27.9 years (SD=9.89) while the non-users are 36.6 years old (SD=11.25); over 70 percent of the SMS users are less than 35 years old. Despite the average user of the mobile phone being fairly young, the SMS users have been using mobile services longer (3.9 years, SD=35.39) than the non-users (3.3 years, SD=31.90). While the distribution of the users is similar between urban and rural, it was found that a large proportion of the non-users live in rural areas (73%). The reported daily income[6] was higher among the users (USD2.88, SD=2.80) than among the non-users (USD 1.51, SD=2.58). The non-users tend to have lower education as 83 percent of the non-users had only primary schooling or no formal education. The users also have a higher level of access to other media such as TV, radio and personal computers than the non-users.

Table 2. Demographics of SMS Users vs. Non-Users

Demographic		Mobile Owners	SMS Users	SMS Non-Users
Overall Percent (%)		100	32.2	67.8
N		(4926)	(1585)	(3341)
Gender	Female	42.7	41.4	43.3
	Male	57.3	58.6	56.7
	Chi-Square (N)	***100***	***1.686 (4925)***	
Age	Less than 35 yrs	58.6	76.6	50.0
	35 yrs or more	41.4	23.4	50.0
	Chi-Square (N)	***100***	***313.6*** (4924)***	
Marital	Married	79.3	49.2	80.3
	Other	29.6	50.8	19.7
	Chi-Square (N)	***100***	***497.9*** (4925)***	
Education	Primary or less	75.1	58.4	83.0
	Secondary or more	24.9	41.6	17.0
	Chi-Square (N)	***100***	***348.3*** (4915)***	
Location	Urban	31.3	40.7	26.8
	Rural	68.7	59.3	73.2
	Chi-Square (N)	***100***	***96.283*** (4926)***	
Media Access	Access to TV (%, Yes)	77.3	90.8	70.9
	Chi-Square (N)		***242.0*** (4920)***	
	to Radio (%, Yes)	39.1	40.7	34.0
	Chi-Square (N)		**110.8*** (4915)**	
	to Computers (%, Yes)	6.2	10.3	4.2
	Chi-Square (N)		***67.9*** (4909)***	

*** *p<0.001*

[6] Income difference is based on 'reported measures' and need to be taken with caution. People tend to avoid reporting their actual income, or fail to recall especially when their income is low and irregular. The questionnaire had several measures of income (regular/irregular, daily/weekly/monthly/yearly, personal/household etc.), and we chose the monthly income measure that had the most responses (N=1300) and calculated the daily income (monthly income x 12/365).

Among the users, SMS was sent or received frequently: 34 percent of the SMS users reported that they used SMS several times a day and 32 percent used it at least once or twice a day. Over 70 percent of the users are aware of the various information and financial services available through SMS such as payment and banking, government, agricultural and livelihood information, entertainment and general services (news, weather etc.). However, the actual usage of such services is reported as being as low as 17 percent of the SMS user group.

Among the non-users, we asked the reasons for not using SMS (see Table 3). Contrary to the commonsense notions, the cost and language barriers were ranked low. Instead, the respondents reported difficulties relating to technical usability (20.9%) such as typing and browsing, followed by general cognitive difficulty (20.2%) in understanding the procedures in using SMS. Although all non-users own their personal mobile phones, 17.3 percent were not aware that SMS service is present on their phones. The non-users also found that SMS is time-consuming (9.8%), which may be related to technical difficulty, but may also be true for those

Table 3. Barriers to SMS Use (Non-users, N= 3341)

Rank	Barriers (Reasons for not using SMS)	%		Counts*
1	***Technical Difficulty***	*20.94*		
	It's difficult to type		*13.11*	821
	It's difficult to browse and open		*9.80*	614
2	***Cognitive Difficulty***	*20.17*		
	Using SMS is confusing to me		*20.17*	1263
3	***Unawareness***	*17.27*		
	I don't know what it is		17.27	1082
4	***Time-Consuming***	*9.80*		
	It takes too much time to use it		*9.80*	614
5	***Lack of Benefits***	*9.41*		
	I don't see any benefits of using it		*5.48*	320
	SMS does not fit into my lifestyle		*1.78*	269
6	***Lack of Social Influence***	*8.82*		
	I don't know anyone I can send SMS to		*5.48*	343
	No one has sent me an SMS before		*1.78*	112
	People in my community don't like SMS		*1.55*	97
7	***Language Barriers***	*7.79*		
	I cannot read or write (my language)		*6.37*	399
	SMS is not available in my language		*1.42*	89
8	***Cost Barriers***	*3.19*		
	It's too expensive for me		*3.19*	200
9	***Lack of Trust***	*2.61*		
	I don't trust SMS in delivering what I want to say		*1.62*	*101*
	I'm afraid it fails to deliver my message		*0.99*	*62*
	Total	100		6262

* Multiple Choice Questions answered by the Non-users

who are capable of sending/receiving an SMS, but value their time and effort higher than the associated perceived benefits. Some users (9.4%) also see no benefit of using SMS in their everyday functioning. A significant proportion of people ranked the lack of social influence as a main barrier (8.8%) indicating that SMS is not accepted within their social networks. Illiteracy was a problem to some users (6.4%). The factors relating to the service provision such as the unavailability of local language (1.4%), cost barrier (3.2%), and the lack of trust in the service (2.6%) were ranked low. In other words, the main barriers to non-use are not the structural obstacles such as financial constraints or illiteracy. Rather, it can be argued that the decision is based on an individual user's assessment of the SMS in terms of technology (difficult usability) and service (lack of values).

(2) SEM Analysis: Facilitators to SMS Use

Since the perceived benefit measures were created by the researchers as an exploratory study based on the existing ICTD literature, we first performed an exploratory factor analysis (EFA) with varimax rotation to identify the statistically significant factors. Both *scree* plot and the *eigenvalue* criteria clearly indicated only two factors: *growth* and *efficiency*. All scales, except for *social benefits*, factored as expected (factor loadings for the specific scales recorded a loading in excess of .50 for each scale). Accordingly, the construct *perceived social benefit* was dropped from further analysis. Two items with cross-loadings and weak scores were also removed (Costello and Osborne, 2005).

A confirmatory factor analysis (CFA) was employed as a more rigid statistical procedure to assess the dimensionality and the validity of all measures. In particular, a CFA can assess the convergent and discriminant validity of the studied constructs in the measurement model. SPSS-AMOS (version 18.0) was used as the analytical tool for the estimation of the measurement model as well as the structural path model. All coefficient alphas, except *social support*, were substantially higher than the generally recommended benchmark of .70 (Churchill, 1979) . The descriptive statistics, Cronbach's alpha values, composite reliability, and standardized factor loadings are reported in Table 4.

The convergent validity (i.e., the degree of association between measures of a construct) and the composite reliability (i.e., the internal consistency of the indicators measuring each CFA construct) were tested and the results were satisfactory. The discriminant validity (i.e., the degree

to which items of constructs are distinct) was empirically assessed by using the variance-extracted test. The criterion to examine the discriminant validity is to check whether the variance shared between measures of two different constructs (the squared correlation) is less than the amount of variance extracted for the items measuring each construct.

Table 4. Measurement Model Tested

Construct	Mean (S.D.)	Standardized Loading	Average Variance Explained	Composite Reliability (Reliability / α)
Growth	3.27 (1.20)		0.53	0.82 (.82)
G1		0.809***		
G2		0.728***		
G3		0.695***		
G4		0.686***		
Efficiency	4.46 (0.65)		0.44	0.76 (.74)
E1		0.685***		
E2		0.628***		
E3		0.661***		
E4		0.671***		
Perceived Value for Money	4.05 (0.89)		0.72	0.84(.84)
PVM1		0.869***		
PVM2		0.827***		
Social Influence	3.85 (0.90)		0.64	0.84 (.84)
SI1		0.866***		
SI2		0.688***		
SI3		0.84***		
Self Efficacy	4.02 (0.76)		0.48	0.73 (.73)
SE1		0.616***		
SE2		0.737***		
SE3		0.721***		
Social Support	3.93 (0.90)		0.48	0.64 (.64)
SS1		0.627***		
SS2		0.749***		
Perceived Usefulness	4.27 (0.69)		0.60	0.86 (.85)
PU1		0.790***		
PU2		0.813***		
PU3		0.765***		
PU4		0.721***		
Perceived Ease of Use	4.24 (0.70)		0.58	0.81 (.81)
PEU1		0.759***		
PEU2		0.782***		
PEU3		0.749***		
Intention to Use SMS	4.25 (0.78)		0.73	0.84 (.84)
IU1		0.884***		
IU2		0.818***		

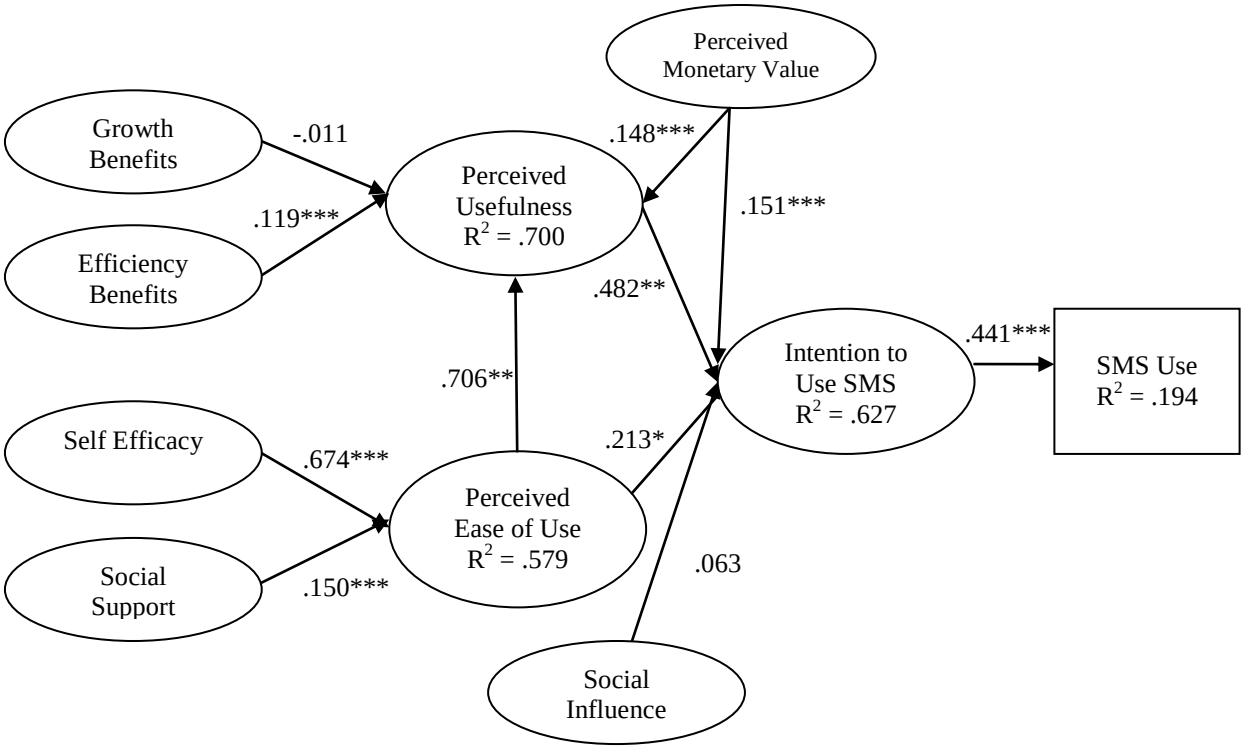
To assess the overall fit of the measurement model, we reviewed a number of goodness-of-fit indices including RMSEA (.047), CFI (.947), TLI (.936), and a Chi-square value of 852.0 (degree of freedom = 228; $p < 0.05$). Though the chi-square value is significant, this result is

expected in large samples. However, according to the criteria summarized in Hair et al. (2010), a battery of fit indices reveals a good fit between the proposed model and the data. In order to check whether normalizing the data yields superior results, the bootstrap procedure was used to obtain the Bollen-Stine p-value for the overall model, and the bias-free estimates for the model parameters. The bootstrap procedure yields a mean chi-square value of 328.26 (degree of freedom = 228; $p < 0.05$), which does not indicate a significant improvement over the results obtained without the bootstrap procedure. Similarly, the parameter estimates obtained through the bootstrap procedure, were not significantly different from those obtained without the procedure. Therefore, the results reported in this paper are those obtained without the bootstrap procedure.

Next, we conduct a path analysis to test the proposed model (as shown in Figure 1). The goodness-of-fit indices for the model were: RMSEA .052; CFI .929, TLI .917; and a Chi-square value of 1109.93 (degree of freedom = 325; $p < 0.05$). Observation of the model fit indices as well as the magnitudes and directional signs of the standardized regression weights led us to the conclusion that the results of the structural path model provides support to all hypotheses except H5 and H10 (H7 was not tested in the final model).

Our model achieved an R^2 value of 0.579 for *perceived ease of use*, 0.700 for *perceived usefulness*, 0.627 for *intention to use SMS*, and 0.194 for SMS use. Nine of the eleven hypothesized relationships are supported by the data (H7 was not tested, and one hypothesis was not supported by the data). Overall, the proposed model provides a good explanation of the BOP users' use of mobile SMS services. Three of the predictors (*perceived usefulness*, *perceived ease of use* and *perceived monetary value*) in our model were found to be important drivers of intention to use SMS. *Social Influence* was not found to be a statistically significant predictor to SMS use intention. *Efficiency benefits* significantly affects *perceived usefulness*, while *self-efficacy* and *social support* affect *perceived ease of use*.

Figure 2. Model Tested



H7was not tested. *** indicates significance at p < .001 level; ** indicates significance at p < .01 level; * indicates significance at p < .05 level;

6. Discussion

This paper examined SMS usage behavior among mobile phone owners at the Bottom of the Pyramid. We found that having a mobile phone does not necessarily mean actively using SMS services even though they have the access at hand. In fact, only 32 percent of the BOP mobile owners in the studied Asian countries have ever sent or received an SMS. We also found that there are significant socioeconomic differences between the SMS users and non-users. The patterns of the digital divide were found in relation to age, income, education and location, except gender. The data showed that SMS services have not yet reached the majority of the older, poorer people with little or no formal education in rural areas, despite the fact that the average non-SMS users also owned the mobile phone for longer than 3 years. Whether SMS adoption will follow the S-curve diffusion (Rogers, 1995) is yet to be seen. The non-users pointed out that the barriers exist in the issues relating to technical or cognitive usability rather than the commonly-assumed structural problems such as affordability or literacy. The findings on the

SMS barriers reaffirm our assumption that, unlike users in developed countries, these BOP mobile users are less exposed to other text-based electronic communication and are therefore less adept at exchanging messages through mobile devices. We suggest that the rapid surge of texting culture that we have seen in developed countries may not occur among the poorest of the poor in developing countries with the current limitations of SMS usability and user interface.

Regarding the drivers of SMS use among users of mobile phones, we tested the extended TAM framework with the antecedents to PU and PEOU. Contrary to our expectations and conventional notions regarding social benefits of mobile phones, our EFA results showed that only two perceived benefit factors emerged from the data, *perceived growth* and *perceived efficiency*, and that *social benefits* did not appear as a significant factor. It can be interpreted that the BOP mobile phone users prefer to use SMS as a means of practical communication relating to work and daily business rather than for intimate and bonding communication with those that they share a personal relationship. Alternatively, it may indicate that these users may use SMS for social purposes but the changes caused by such uses may not be significant since people in developing countries, especially in rural areas, tend to have a smaller and closer social network where face-to-face communication is predominant.

The proposed model shows that the *perceived usefulness* (PU) and *perceived ease of use* (PEOU), along with *perceived monetary value* (PMV), are strong indicators of the SMS use among the BOP users. On the other hand, *social influence* was not a significant predictor of SMS use intention in our analysis. The strong effect of PU is consistent with existing literature from developed countries, indicating that BOP users also tend to make choices primarily based on their own assessment of the utility of a technology, rather than being driven by financial or social influences. We found that this 'usefulness' of SMS is explained primarily by *perceived efficiency benefits* and PEOU, indicating that the BOP users find the SMS services useful when the service helps them manage their daily businesses more efficiently in addition to being easy to use. Contrary to our hypothesis, perceived growth benefit has no significant effect on PU. We argue that the new capability of contacting and being contacted through mobile phones and SMS has the most benefits on increasing 'efficiency' of the BOP users by allowing them to better coordinate and organize their life. We also found that the BOP owners tend to find the SMS service easy to use when they have the support from others and when they have a high self-efficacy towards the services.

7. Implications

The study contributes to the existing literature in information systems, communications and ICT for development research. First, it examines the mobile user behaviors in developing countries with a particular focus on SMS use among the BOP. Drawing the sample from an under-studied population, this study fills the gap in our understanding of those that have newly joined the mobile user base while broadening our knowledge on the role of mobile communications in the Global South. Second, this study extends the TAM framework in the context of developing countries. The extended model, with the three significant antecedents to PU and PEOU, offers detailed understanding on the motivations of the SMS use. In addition, using the widely adopted measures of PU and PEOU, the study allows the comparison of the TAM variables between developed and developing countries. Third, the study provides empirical evidence of mobile user behavior based on solid quantitative analysis. This study acknowledges that the current ICTD research is in need of empirical evidence based on rigorous quantitative methodology. The present study offers new findings on the SMS user profiles and their decision-making process based on a randomly drawn sample and SEM analysis.

The findings of this study also have implications for ICTD practitioners. We argue that the quantity of mobile phones in the Global South does not automatically translate into the high quality impact of mobile communication. In fact, the path between mobile access and developmental impact seems to consist of multiple stages of mobile service adoption and utilization. While many development practitioners currently make positive assessments about the growing penetration of mobile phones in developing countries, it is still uncertain how these mobile phones can bring positive benefits to the poor, and what types of services can lead to socioeconomic development.

SMS is currently the most popular platform to deliver such intervention services due to its efficiency and convenience that allow practitioners to reach a large population. However, our findings suggest that the adoption rate of SMS is still low among the BOP and the dynamic use of m-services beyond voice calls are still limited. Based on our findings, the study suggests the following recommendations to ICTD practitioners who plan to integrate mobile SMS services into their development programs.

Making a mere provision of information via SMS may not reach the mobile owners who use mobile phones mainly for voice calls, in particular the poorest and the least educated of the poor. The study found that the barriers to SMS adoption are beyond the issues of affordability and literacy and the problem lies in the current limitations on usability and the lack of familiarity with text-based communications. Hence, we expect that the key challenge for the ICTD practitioners is to address the issue of non-adoption, which can probably be encouraged with simple and easy-to-understand messages that may trigger interest among the recipients. SMS-based intervention services need to pay more attention to usability of the messages delivered – for instance, a series of short and interesting messages possibly aided with graphical contents can be more effective than a long 140 character message full of official information. Also, the study found that ease of use can be enhanced by increased self-efficacy to use SMS, and technical support within the user's social surroundings. We suggest that additional programs, such as community-based trainings, service promotion and public campaigns should be offered during the onset of such m-service projects.

In addition, we found that the main drivers of SMS adoption is useful content and services that can appeal to the BOP by increasing efficiency in organizing and managing their everyday activities. Current m-services are concerned more with providing information (i.e. agricultural tips, health information, election and government information, etc.). Rather than offering a package of information that is perceived as "useful" by the providers, it is important that the utility of the SMS-services be understood from a perspective of the users at the BOP. The design of such m-services also needs to be contextualized sufficiently to address the direct and visible benefits relating to the BOP's everyday activities. To do so, we suggest that the ICTD practitioners should take a closer look at the everyday needs of the users at the BOP, and design services perceived as useful by them.

8. Limitations and further research

The present study has several limitations. First, the findings are based on subjective measures using self-reported survey data. Although the '*perception–intention-use*' framework is a well-established relationship in social psychology research, scholars argue that the perception measures are less congruent with the objective usage measures such as computer-recorded log data (Straub & Limayem, 1995). However, this approach has a clear advantage in illustrating the

detailed motivations affecting use of a specific technology. However, further research needs to employ more diverse methods such as controlled field experiments, the diary method, or obtain user data from mobile operators; more objective measures also need to be incorporated. Second, the perceived benefits of mobile phone usage need to be investigated further. Although our study makes an initial attempt to examine the perceived benefits with exploratory factor analysis, it limits the scope of the benefits as direct instrument gains. Further study should include a broader set of the benefits including entertainment and recreation, emotional support, security, symbolic status and so forth. Finally, the role of social influence needs to be defined further. The study uses a narrow definition of social influence mainly in terms of everyday interactions. Further research is encouraged to explore the multiple layers of social effects from vicarious learning, mass media and public campaigns, community norms, social structure and culture.

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