The Digital Divide and Barriers to Mobile Internet Adoption

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Abstract

This paper identifies and discusses potential barriers to the adoption of mobile Internet, as experienced by digitally disadvantaged users in order to gain a better insight into why this technology has not as yet diffused widely. Until now, little quantitative data has been available to describe exactly how being digitally disadvantaged influences a person's decision to adopt mobile Internet. This paper reports a quantitative study which surveyed almost 100 adopters and non-adopters of mobile Internet from both sides of the digital divide in Cape Town, South Africa.

This paper uncovered the fact that being digitally disadvantaged does have a significant impact on the adoption of mobile Internet. The factors that were found to influence the adoption decision by digitally disadvantaged users are cost, awareness, a lack of knowhow and perceived risk. This is of particular importance to mobile network operators, who may be aiming to increase mobile data sales among the resource-scarce but also to numerous South Africans living on the "wrong" side of the digital divide.

1. INTRODUCTION AND BACKGROUND

Despite being the second most populated continent after Asia, the number of broadband subscribers in Africa is still rather small. By the end of 2006 African broadband subscribers accounted for less than 0.4 percent of the 281 million broadband subscribers in the world. Two of the most obvious reasons for this are limited computer literacy and prohibitively high tariffs (ITU, 2007). This inequality in access to information technology is referred to as the digital divide (Fallis, 2003).

Mobile phones can be seen as one way of bridging the digital divide (Dholakia & Kshetri, 2002; Tongia, 2006). Mobile Internet has the potential to provide access to information from any place, at any time. Although mobile device penetration exceeds personal computer penetration worldwide, many people are still reluctant to adopt mobile Internet. To understand the concerns of customers and to know which factors can act as potential barriers to the adoption of mobile Internet is a key success factor for a more wide ranging adoption of mobile Internet (ITU, 2007).

Although there is evidence to suggest that mobile Internet is a potential tool for bridging the digital divide in South Africa (Chigona, Beukes, Vally & Tanner, 2009), there appears to be limited research available to explain the adoption of mobile Internet (**MI**) services due to these services' complexity and convergence (Carroll, Howard, Vetere, Peck & Murphy, 2002). This is especially true in a South African context (Ramburn, 2007). In addition, there is a dearth of information on the impact which digitally disadvantage has on the adoption of mobile data services, especially mobile Internet. Therefore, this research investigates the potential barriers, as well as the impact of being digitally disadvantaged, to the adoption of mobile Internet.

This paper reports on an empirical research project done among cell phone users in the Cape Metropolitan area. It focuses on Internet access by means of use of mobile phones, as opposed to Personal Digital Assistants (PDA's) or other mobile devices. It considers on the initial adoption of mobile Internet and not its continued use. For purposes of this paper the terms ***MI users*** and MI non-users are used to refer to consumers that either have or have not adopted mobile Internet and do not imply the continued use of the service. A person who does not readily have access to the Internet, be it at home or at work, is deemed to be ***digitally disadvantaged*** or on the "wrong" side of the digital divide.

The objective of this research project was to ***highlight which issues needs to be addressed in order to achieve a more wide range adoption of mobile Internet by digitally disadvantaged people.*** This research objective was broken into the following research questions:

1. ***Which factors are barriers to the adoption of mobile Internet?***
2. ***Does being digitally disadvantaged have a significant impact on the adoption of mobile Internet?***

This research project suggests a contingency model that investigates the impact of being digitally disadvantaged on the constructs of the Sarker and Wells (2003) model. It therefore contributes to the existing technological research literature in South Africa. This research will also be of practical value to the mobile network operators in South Africa because cell phone penetration is nearing saturation point in South Africa. Thus market growth will have to come from other revenue streams, such as mobile data services. However, market adoption of these services has been slow (Ramburn, 2007) and this research may provide insights in why this is so. .

2. LITERATURE REVIEW

1. Role of mobile ICT in addressing the digital divide

Dholakia, Dholakia, Lehrer and Kshetri (2004) identify mobile telecom networks as leapfrogging alternatives to fixed line telecom networks that can expedite the bridging of the digital divide in developing countries. This development will extend access to information to previously unserved population groups, including rural users and the urban poor (Oestmann, 2003). Leapfrogging can be defined as the ability to bypass previous investments in development costs and time. Mobile technology can therefore be seen as a viable alternative to costly and time-consuming fixed line telecom infrastructures for many reasons, including the overcoming geographic barriers, lowering installation costs and lowering social barriers to adoption (Dholakia & Kshetri, 2002; Dholakia et al., 2004; Oestmann, 2003).

The main role of ICT in addressing the digital divide is to integrate any newly acquired knowledge into society for purposeful action and reaction (Urquhart, Liyanage & Kah, 2007). As such, technology does not exist as an external entity, introduced from the outside to bring about certain changes and should rather be seen as something integral to processes and systems. When new technology is introduced to the digitally disadvantaged, the aim should not only be to bridge the digital divide but also social inclusion (Warschauer, 2003).

Owing to this, the use of mobile ICT in addressing the digital divide should be focused on relevant content (in multiple languages), promoting education and literacy and mobilising communities towards achieving common goals (Fallis, 2003; Warschauer, 2003).

2. Mobile Internet

Mobile Internet can be defined as wireless access to the contents of the Internet through the use of mobile devices (Chae & Kim, 2003) and is a fast growing enabling technology for m-commerce (Kim, Chan & Gupta, 2007). Mobile commerce, or m-commerce, can be described as any direct or indirect commercial transaction that is conducted with mobile devices over a wireless telecommunications network. M-commerce applications can be grouped into two categories: transactions (i.e. purchasing) and content delivery (i.e. reporting and notifications) (Bhatti, 2007). Kim et al. (2007) refer to m-commerce as basically any e-commerce transaction that is done in a wireless environment. Mobility and reach are the major characteristics that differentiate m-commerce from other forms of e-commerce (Bhatti, 2007; Kim et al., 2007).

The main requirement for the success of m-commerce is mobile phones that are data-ready and connected to digital communications networks (Dholakia et al, 2004; Sarker & Wells, 2003) as well as the willingness of consumers to adopt and use new technology (Bruner & Kumar, 2003). Gilham and Van Belle (2005) argue that one should be careful not to see m-commerce as the Internet rendered accessible from a mobile phone, since the richness provided by PC's is not substitutable nor replaceable by the mobile handset.

Patel (2008) estimates that there were 400 million mobile Internet users at the end of 2008 and predicts that this number will grow to 700 million by 2012. This big increase in adoption will be driven by the demand for access to popular web content, social networks, webmail, news and entertainment sites. This is confirmed by Drego, McInnes and Zinser (2009) who indicate that 65% of users have used the mobile Internet to access news sites, while 50% are using the mobile Internet to have access to social networking sites. This is reflected in **Figure 1**.

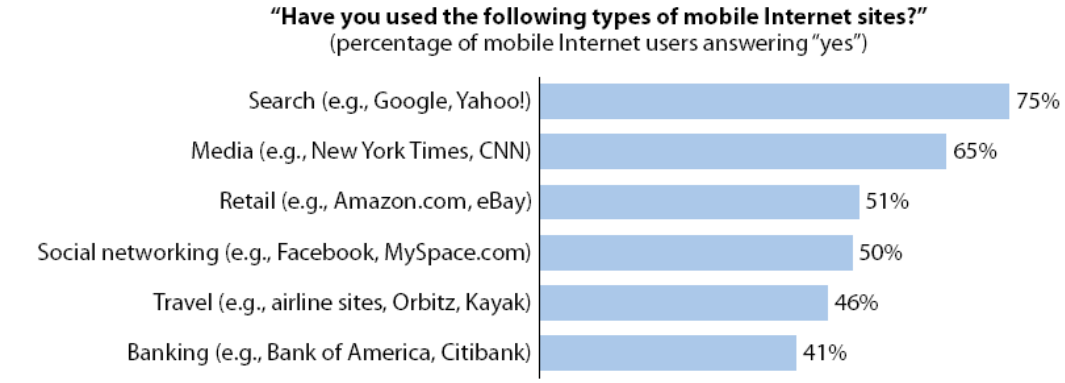

Figure : Sites frequented by mobile Internet users (Source: Drego et al., 2009)

Four main usage categories can be defined for mobile Internet, namely email, instant messaging services (including mobile instant messaging), access to general information and voice-over-Internet-protocol (VOIP) (Chigona et al., 2009). According to Kim et al. (2007) mobile Internet should be divided into 3 C's: commerce (i.e. mobile banking and product purchase), communication (i.e. e-mail and instant messaging) and content (i.e. news and location based services). This includes all scenarios where mobile Internet is used to gain knowledge or access entertainment, where the immediacy of access to the relevant information is important (Cui & Roto, 2008).

In order to cater for a target audience of digitally disadvantaged people, this paper will simplify the concept of mobile Internet by grouping mobile Internet activities into the following types: Communication (email, instant messaging) and Information seeking or fact finding

3. Potential barriers to the adoption of mobile Internet

Despite its potential and inherent benefits, the adoption of mobile Internet services remains slow. At the start of 2008, only 14% of European mobile users regularly used mobile Internet services, despite the fact that virtually all mobile phones in Europe are mobile Internet enabled. Nuthall (2008) believes the answer is that barriers to adoption still outweigh the benefits and that mobile browsing simply is not convenient enough. For instance, only 43% of adults in the United States of America that own mobile phones believe that mobile Internet services are useful and 30% believes that the mobile Internet is a valuable addition to their life (Drego, Rogowski & Geller, 2008).

In an attempt to qualify the potential barriers to a more wide range adoption of mobile Internet, this paper will dissect potential barriers along the four axes of individual, technological, contextual and communicational/task barriers (Sarker & Wells, 2003).

3.1. Individual barriers

Due to low levels of support, low literacy levels and poor technology skills (especially in computing), people from disadvantaged groups are often prevented from accessing and making use of ICT's and accessing the Internet (Cheong & Park, 2005). People in professional occupations are afforded the opportunity to acquire the required literacy and technology skills while the unemployed, manual workers and young people without tertiary education are not (Cullen, 2001).

According to a US industry report, the typical mobile data user appears to be male, between 18 and 34 years old, with a household income of US$ 60 000 or more (Okazaki, 2006). This is reiterated by Economides and

Grousopoulou (2009) who put the percentage of females who do not consider mobile Internet to be important at 45.12%, compared to 37.87% of males. Almost 52% of females prefer not to spend any money on mobile data services whereas only 43.2% of males share this sentiment. Age, gender and income therefore appear to be potential barriers in the adoption of mobile data services in both developed and developing countries (Chen & Wellman, 2004).

3.2. Technological barriers

Technological barriers to the adoption of mobile Internet include the response time of Internet browsers on mobile phones, system accessibility, system reliability and security (Cheong & Park, 2005) with mobile network speed being a top concern for most existing mobile Internet users (Drego et al., 2009; Nuthall, 2008). Drego et al. (2008) write that many users still cite battery power of mobile phones, mobile device hardware and the mobile phone layout design as major barriers to the adoption of mobile Internet.

The inherent problem with mobile phone layout and design is that mobile phones are first and foremost designed for calling and messaging (Kaasinen, 2005) with most users preferring mobile phones that are both small and lightweight (Nuthall, 2008). This leads to some interesting design and usability challenges in integrating Internet functionalities into the menu structure of mobile devices (Kaasinen, 2005).

Since many mobile phones have small screens and limited input capabilities, users find it hard to navigate and read mobile Internet sites. Most claim more familiar displays and layouts, similar to desktop Internet sites, will prompt them to use mobile Internet more frequently (Rubicon Consulting, 2008). The fact that most mobile Internet sites are vertically formatted results in users having to scroll down long pages to find the required information. Since user tolerance for delays is normally lower when on the move and using the mobile Internet only 24% of consumers indicated that mobile Internet sites rendered sufficiently fast enough (Drego et al., 2008).

3.3. Contextual barriers

Behavioural and cultural attitudes towards technology are closely aligned to a lack of skill. These attitudes normally indicate that computers are for males or the young and should only be used by “brainy” people (Cullen, 2001). Many people still express a concern about a perceived lack of security and the amount of unsuitable material that is readily available on the Internet. In many cultures where a high value is placed on strong family networks and personal communication, the use of ICT for the sake of communication is not a high priority (Cullen, 2001).

The content provided by mobile Internet is not considered relevant by many users. A bland and generic suite of mostly entertainment-based content services is normally provided by mobile operator portals (e.g. Vodafone Live provided by Vodacom). Off-portal browsing offers an almost unlimited array of options but very few users are aware of this and it can be quite difficult to reach these sites (Drego et al., 2008; Nuthall, 2008). If the content provided by mobile Internet services is not interesting or relevant to users, they may choose not to access these services (Cullen, 2001). Even though data plans based on flat rates are becoming more common, the main barrier to the adoption of mobile internet is still the high costs associated with it, whether real or perceived (Nuthall, 2008). The majority of mobile Internet users indicate a reduction in cost as the primary change that will encourage and allow them to use mobile Internet more frequently (Drego et al., 2008).

3.4. Awareness barriers

Many people, as much as 50% of all European mobile users, are still unaware of the fact that they can access the mobile Internet via their mobile phones or that there are dedicated mobile sites aimed at improving the mobile browsing experience. This is also the case in South Africa (Ramburn, 2007). Consumer education, in the form of advertising and focused marketing, is therefore something that requires urgent attention to increase mobile Internet adoption (Nuthall, 2008). Marketing campaigns should be focused on educating consumers about the

effectiveness, efficiency and benefits offered by mobile Internet, as opposed to fixed line alternatives (Ramburn, 2007).

Having highlighted potential barriers in the adoption of mobile Internet, it is important to look at the potential research approaches that can be followed in a research project of this nature.

4. Technology acceptance research approaches

To determine potential barriers to the adoption of mobile Internet, for purposes of bridging the digital divide, the following behavioural theories related to the adoption of technology were reviewed and considered: Technology Acceptance Model (TAM), Innovation Diffusion Theory (IDT), Unified Theory of Acceptance and Use of Technology (UTAUT) and the Sarker and Wells (2003) model.

Ramburn (2007) adopted the Sarker and Wells (2003) model in a study to understand the adoption of mobile data services in South Africa and Mauritius and found it worked well in a South African context. As a result, this study will adopt a contingency model based on the Sarker and Wells (2003) model. Additional constructs (i.e. relative advantage and awareness) influencing adoption and use, as identified through research conducted by Ramburn (2007), were added to the original Sarker and Wells (2003) model.

3. RESEARCH METHODOLOGY

The research philosophy for this research project was positivist, which was justified since it attempted to find quantifiable data to validate proposed hypotheses, by means of a contingency model based on the research model proposed by Sarker and Wells (2003).

A survey questionnaire was used to gather quantitative data. This strategy was chosen based on the success achieved through similar studies conducted by Ramburn (2007) and Kreutzer (2008). This study used a non-probability sampling method with the use of the snowballing technique which is not considered generalisable. However, due to time constraints and the inherit difficulties associated with finding digitally disadvantaged respondents, the approach was warranted.

A few modifications were made to the original Sarker and Wells (2003) model due to time constraints and scope limitations. The “Adoption Outcome” factor of the original Sarker and Wells (2003) model was ignored because it focuses on the continued use of the mobile services. Due to the considerable methodological issues associated with measuring culture, the culture construct was replaced with a language construct. An awareness factor and a relative advantage factor were added. The awareness and relative advantage factors were added based on a study conducted by Ramburn (2007). The research was conducted in the Cape metropolitan area and as a result the network coverage construct was also ignored.

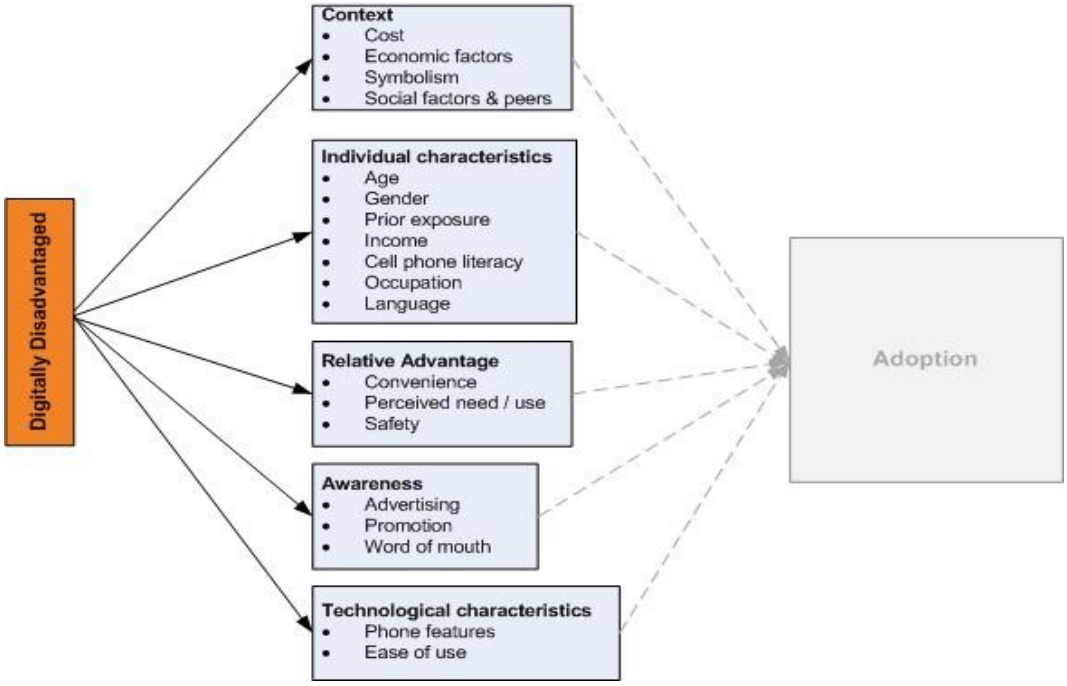

Figure 2 : Proposed research model (Source: Ramburn, 2007; Sarker and Wells, 2003)

Figure 2 indicates that an objective of this research project was to determine the impact of being digitally disadvantaged on the constructs of the Sarker and Wells (2003) model. Since Ramburn (2007) has tested the use of the Sarker and Wells (2003) model in researching the adoption of mobile data services, the dependent variable of "*Adoption / Use*" was not tested again in this research project. **Table 1** provides an explanation of most of the factors and constructs in the proposed research model.

Factors	Constructs	Explanation
User Characteristics	Age	Sarker and Wells (2003) argue that age is a factor which predicts the adoption of mobile technology.
	Language	Users for whom English is not the first language might find mobile Internet sites difficult to understand.
	Cell phone literacy and prior exposure	Refers to an individual's degree of confidence in using mobile phones to perform specific transactions. Sarker and Wells (2003) found this to be a high predictor of mobile usage behaviour.
Context	Cost and economic factors	Some users might find the cost of mobile data services too high while others might consider the cost incurred as fair. Economic conditions might also affect disposable cash available for data usage.
	Peers and social factors	Peers significantly influence the adoption of mobile data services and mobile devices. Users are found to adopt mobile data services when most of the people surrounding them do so.
	Symbolism	It was found that participants used mobile data services because adoption of mobile devices was seen as a status symbol.
Relative Advantage	Convenience, perceived need and safety	Users are more likely to adopt mobile data services such as mobile Internet if they perceive it to be useful, safe and convenient to use.
Awareness	Advertising and promotion	Consumers are more likely to adopt mobile Internet if the services are better marketed and promoted by mobile services providers.
	Word of mouth	Peers can influence users' adoption of mobile Internet by telling them about the service and showing them how to use it.
Technology Characteristics	Cell phone features and ease of use	The importance of an easy to use interface design has been discussed in many studies. Intimidating interface design seems to be a major factor inhibiting adoption of mobile data services.

Table : Explanation of factors and constructs of research model (Source: Ramburn, 2007)

Through the use of a questionnaire, this study attempted to test the following hypotheses by means of the proposed contingency model:

- H1: Context factors (cost, economic factors, symbolism & peers) are influenced by being digitally disadvantaged
- H2: User characteristics (age, gender, prior exposure, income & literacy) are different for those who are digitally advantaged vs. digitally disadvantaged
- H3: Relative advantage factors (convenience, perceived need / use & efficiency) are influenced by being digitally disadvantaged
- H4: Awareness of the technology (via advertising, promotion & word of mouth) are influenced by being digitally disadvantaged
- H5: Technological characteristics (phone features and ease of use) are influenced by being digitally disadvantaged

The instrument was derived from concepts that surfaced in the literature review and from previous studies: Ramburn (2007) conducted research into the adoption of mobile data services in two African countries by applying the Sarker and Wells (2003) model, whilst Kreutzer (2008) conducted a study to assess cell phone usage in South African township schools.

Due to the fact that the research had to be completed within a limited timeframe, the researchers decided to follow a convenient, non-probability sampling approach. Another reason for using this approach was the difficulty involved in identifying digitally disadvantaged people. The researchers distributed the questionnaire to all the cleaning and security staff working for Vodacom in Bellville, Cape Town and Century City. They were initially deemed to be digitally disadvantaged. The questionnaire was also distributed via email to other employees of Vodacom considered to be digitally advantaged, as well as to family members and friends. Since the concept of "*mobile Internet*" might be foreign to digitally disadvantaged people, meetings were arranged with these groups in order to explain both the concept, as well as the research questionnaire.

5. DATA ANALYSIS

1. Respondent Distribution

Figure 3: Respondent distribution

Since there was no way of guaranteeing a perfect split with digitally disadvantaged non-users of mobile Internet on the one side and digitally advantaged users of mobile Internet on the other, the aim was to get a pool of respondents that would represent each of the following 4 groups: disadvantaged non-users, disadvantaged users, advantaged non-users and advantaged users. The fact that the majority of the respondents were in either the disadvantaged non-user or advantaged user groups (**Figure 3**) was considered to be favourable for meaningful data analysis.

The MI non-user (***Ever Used MI = No***) sample initially consisted of 39 respondents while there were **54 respondents** in the MI user (***Ever Used MI = Yes***) sample. After initial analysis was done on the MI non-user group, ten respondents had to be removed due to incorrect completion of the questionnaire. Therefore, this group ended up with **29 respondents**.

The profile of the typical MI user in this study was an English speaking male that is predominantly digitally advantaged with access to the Internet at home and work and with very good cell phone literacy levels. Conversely, the profile of a typical MI non-user in this study is a Xhosa speaking female that is digitally disadvantaged with no access to the Internet at home or work. The typical MI non-user in this study earns less than the typical MI user and is also slightly younger. All these variables are significantly different between the two datasets (see below 4.4.2 with chi-square test statistic < 5%).

2. Validity and reliability testing

It is very important for any researcher to perform validity and reliability checks in order to ensure the dependability, strength and consistency of test items in a research instrument (Boudreau, Gefen & Straub, 2004). Validity and reliability checks were performed on two datasets, namely MI users and MI non-users.

2.1. Construct validity

The researcher used factor analysis to test the validity of the proposed research model. To ensure a clear and distinctive factor loading, factor analysis testing was done using Varimax normalised as the rotation method. Due to the fact that the study was conducted on a relatively small dataset, a cut off value of 0.5 was used. Ramburn (2007) also used a cut off value of 0.5 in factor analysis to test for the validity of constructs.

Despite a test item related to economic factors not loading for the **MI user dataset**, most of the other test items for this sample show high clean loadings. A total of eleven factors were identified which explains 77.93% of the variance in the model.

Initial factor analysis that was performed on the **MI non-user dataset** resulted in non-homogenous loadings. Closer inspection of the completed questionnaires highlighted the fact that some respondents in this sample did not pay careful attention whilst completion the questionnaire or they were just not interested in completing the questionnaire. As a result, ten respondents were deleted from the dataset. A test item related to "*Promotion*" of mobile data services did not load significantly in any factor in the MI non-user dataset. A "*Convenience*" and "*Perceived need*" test item had to be recoded after initial factor analysis resulted in negative loadings for these test items.

In the end, a total of seven factors were identified which explains 77.90% of the variance in the model. The test items for "*Awareness*" did not load on their own but rather with the test items for the "Context2" construct. An explanation for this can be found in the wording of these test items which are very similar and refers to being informed, told or influenced to use mobile Internet. Relative low loadings for two "*Ease of use / Text input*" test items, as well as the "*Bandwidth*" test item was expected and can be explained by the fact that respondents in the MI non-user sample have never used mobile Internet before.

2.2. Construct reliability

After performing validity tests (factor analysis) the researcher performed reliability analysis (Cronbach Alpha) to test for construct reliability and to test how well the questions for the variables in the research model fit together or how homogenous they are. Cronbach Alpha values were calculated on the constructs having two or more related test items in the two datasets. Previous studies conducted by Ramburn (2007) and Ha, Yoon and Choi (2007) have used Cronbach Alpha values higher than 0.5 to indicate good reliability between constructs.

Only one Cronbach Alpha value of the **MI user dataset** was below 0.50: "*Relative Advantage2*" (at 0.38). Most of the Cronbach Alpha values of the **MI non-user dataset** exceeded 0.62, with the exception of the "*Relative Advantage1*" and "*Technical Characteristics2*" constructs whose coefficients were 0.46 and 0.43 respectively.

Based on the data there was a need to exclude Questions 2.3 and 2.16 from the MI user dataset and Questions 3.15 and 3.17 from the MI non-user dataset in order to improve item reliability.

3. Regression tests

This section focuses on validating the model through the testing of hypotheses. A p value of <5% was deemed to be significant with a p value <1% highly significant.

3.1. Context factors

H_1: Context factors (cost, economic factors, symbolism & peers) are influenced by being digitally disadvantaged

a) **MI users**

Dependent Variable	R	Beta	t	Sig - p	Description
CONTEXT1	.090	-.090	-.640	.525	MI too expensive
CONTEXT2	.273	.273	1.985	.053	Use MI influenced by others and by advertising, has a status attached (trendy & for rich people)

Table : Context factors - MI users

Table 2 indicates that being digital disadvantaged do not have a significant impact on the "*Context*" constructs for the MI user sample. The "*Context1*" construct has a negative Beta value, indicating that the more digitally advantaged a consumer is, the less an issue the cost of mobile Internet will be. With a p value of 0.525, this impact is however not significant.

a) **MI non-users**

Dependent Variable	R	Beta	t	Sig - p	Description
CONTEXT1	.510	.510	2.963	.007	MI access restricted by current economic situation (not affordable)
CONTEXT2	.394	.394	2.099	.046	Use MI influenced by others and by advertising, has a status attached (trendy)

Table : Context factors - MI non-users

Being digitally disadvantaged has a significant impact on both "Context" constructs for the MI non-user sample. This can be seen in **Table 3**. Regression tests indicate that being digitally disadvantaged has a highly significant (p=0.007) impact on the "*Context1*" construct with a positive Beta value. This implies that the more digitally disadvantaged a consumer is, the more access to mobile Internet will be restricted by the consumer's economic status. The cost of mobile Internet therefore has a significant impact on these consumers. Similarly, being digitally disadvantaged has a significant impact on the "*Context2*" construct for the same sample. The more digitally disadvantaged consumers are, the more they will be influenced to start using mobile Internet by advertising and the more they will perceive mobile Internet to be trendy.

This information supports the hypotheses that context factors are influenced by being digitally disadvantaged. However, this is only true for users that have not yet adopted mobile Internet.

3.2. User characteristics

H_2: User characteristics (age, gender, prior exposure, income & literacy) are different for those who are digitally advantaged vs. disadvantaged

Profile	DIGITALLY ADVANTAGED	DIGITALLY DISADVANTAGED	Chi-Square Test Statistic	Asymp. Sig. (2-sided)
GENDER	Mainly male	Mainly female	9.234	.002
LANGUAGE	Dominant English	Dominant Xhosa	32.329	.000
AGE	*No significant difference*	*No significant difference*	3.343	.647
MONTHLY INCOME	Higher	Lower	39.246	.000
CELL PHONE LITERACY	On average very good	On average good	12.668	.013
OCCUPATION	Mainly specialists	Mainly cleaners	63.125	.000
INTERNET AT WORK	Most yes	Most no	75.189	.000
INTERNET AT HOME	Most yes	Most no	51.047	.000
PREPAID OR CONTRACT	Mainly contract	Mainly prepaid	35.752	.000
CELL PHONE OPERATOR	Mainly Vodacom	Mainly MTN	26.280	.000
KNOW WHAT MI IS	Most yes	Most no	44.108	.000
EVER USED MI	Most yes	Most no	32.196	.000

Table : Individual characteristics - Comparative profiles

As can be seen in **Table 4**, all the individual characteristics of the digitally advantaged users, except for age, is significantly different from those of the digitally disadvantaged users in this study. The individual characteristics of the respondents suggest that the average digitally advantaged mobile consumer is an English speaking male who has very good cell phone literacy and access to the Internet at home and work. These users typically make use of cell phone contracts and they know what mobile Internet is and have used it before. Conversely, the typical digitally disadvantaged user in this study is a Xhosa speaking female who has good cell phone literacy but does not have access to the Internet either at home or work. Most of these users do not know what mobile Internet is and most have also never used the technology before. Maybe not surprisingly, the income of the digitally advantaged users is significantly higher than those of the digitally disadvantaged users.

This information supports the hypothesis that user characteristics are different for those who are digitally advantaged vs. digitally disadvantaged, and the null hypothesis is therefore rejected.

3.3. Relative advantage factors

H_3: Relative advantage factors (convenience, perceived need / use & efficiency) are influenced by being digitally disadvantaged

a) **MI users**

Dependent Variable	R	Beta	t	Sig - p	Description
REL. ADV1	.424	-.424	-3.310	.002	MI is convenient
REL. ADV2	.005	.005	.037	.971	Don't use MI as no need or previously disappointed
REL. ADV3	.095	.095	.678	.501	Use MI when no access via landline. MI gives sense security but can also expose to virus

Table : Relative advantage factors - MI users

Being digitally disadvantaged has a highly significant impact (p=0.002) on how convenient ("*Relative Advantage1*" construct) mobile Internet is perceived to be by current users of the technology. This is displayed in **Table 5**. The negative Beta value for this construct implies that the more digitally disadvantaged current MI users are, the less convenient they will perceive the technology to be. The "*Relative Advantage2*" and "*Relative Advantage3*" constructs are not significantly influenced by users being digitally disadvantaged.

a) **MI non-users**

Dependent Variable	R	Beta	t	Sig - p	Description
REL. ADV1	.344	.344	1.869	.073	MI usage will offer convenience but is restricted by lack of know-how
REL. ADV2	.526	.526	3.091	.005	MI may be useful but also 'dangerous' (virus, no privacy) and stressful

Table : Relative advantage factors - MI non-users

Table 6 shows that being digitally disadvantaged has a highly significant impact (p=0.005) on the "*Relative Advantage2*" construct for the MI non-user sample. With a positive Beta value this implies that the more digitally disadvantaged users are, the more they will perceive the use of mobile Internet to be stressful and dangerous, with the potential of infecting cell phones with viruses. These consumers are also concerned that the use of mobile Internet might lead to a lack of privacy. **Table 6** also indicates that being digitally disadvantaged do not have a significant impact on the convenience factor ("*Relative Advantage1*" construct) of mobile Internet as far as MI non-users are concerned.

Therefore, this information supports the hypotheses that relative advantaged factors are influence by users being digitally disadvantaged. This is true for both the MI user and MI non-user sample.

3.4. Awareness factors

H_4: Awareness of the technology (via advertising, promotion & word of mouth) is influenced by being digitally disadvantaged

a) **MI users**

Dependent Variable	R	Beta	t	Sig - p	Description
AWARENESS1	.051	-.051	-.363	.718	MI usage stimulated by adv & promotion
AWARENESS2	.254	.254	1.841	.072	MI usage motivated by incentive and third party advise

Table : Awareness factors - MI users

Table 7 shows that for current users of mobile Internet, being digitally disadvantaged has no significant impact on the awareness constructs of the research model.

Reliability tests that were performed on the constructs of the research model (Section 5.4.1) indicated very low Cronbach Alpha values for the Awareness construct for the MI non-user sample. This resulted in Awareness construct being removed from the research model applied to MI non-users. This finding validates the original Sarker and Wells (2003) model which does not include the "*Awareness*" construct and suggests that, for non-users of the technology, awareness of mobile Internet is not influenced by being digitally disadvantaged. The null hypothesis could therefore not be rejected.

3.5. Technological characteristics

H_5: Technological characteristics (phone features and ease of use) are influenced by being digitally disadvantaged

a) **MI users**

Dependent Variable	R	Beta	t	Sig - p	Description
TECH. CHRC1	.251	-.251	-1.832	.073	Mi too restrictive (screen, keyboard, interface, etc.)
TECH. CHRC2	.101	.101	.710	.481	MI limited by limited battery resource
TECH. CHRC3	.179	-.179	-1.303	.199	MI use restricted by bandwidth /download speed
TECH. CHRC4	.184	.184	1.327	.191	MI use difficult (registration, set up)

Table : Technological characteristics - MI users

The high p values of most of the technological characteristics constructs in **Table 8** imply that technological characteristics are not significantly influenced by MI users being digitally disadvantaged.

b) **MI non-users**

Dependent Variable	R	Beta	t	Sig - p	Description
TECH. CHRC1	.027	-.027	-.135	.894	MI too restrictive (screen, keyboard, interface)
TECH. CHRC2	.154	.154	.811	.424	MI use restricted by bandwidth /download speed
TECH. CHRC3	.320	.320	1.618	.119	MI use is difficult (complicated registration, setup). Don't need it and present handset cannot support MI

Table : Technological characteristics - MI non-users

Table 9 shows that for MI non-users, technological characteristics are also not significantly influenced by users being digitally disadvantaged. An explanation for the high p values may be the fact that the digitally disadvantaged non users of mobile Internet have never used the technology before and have are therefore not affected by characteristics such as the small screen and keyboard of cell phones and the perceived difficulty associated with the use of mobile Internet.

Therefore, even though Ramburn (2007) suggests that the technology variable is one of the most crucial aspects of the Sarker and Wells (2003) model, being digitally disadvantaged do not appear to have an impact on this variable. This information suggests that the null hypothesis could not be rejected.

6. IMPLICATIONS

1. Findings and recommendations

This section summarises the key findings of the Data Analysis chapter (**Chapter 5**) and also provides a number of practical recommendations. It is important to reiterate that in the context of this research, being digitally disadvantaged refers to the lack of access to Internet infrastructure.

1.1. Which factors can be considered barriers to the adoption of mobile Internet? (Research Question 1)

The research objective of this study was to highlight what needs to be addressed in order to achieve a more wide range adoption of mobile Internet by digitally disadvantaged people. This section therefore only focuses on the results of data analysis done on the MI non-user sample.

There is a significant correlation ($p=0.007$) between being digitally disadvantaged and the affordability of mobile Internet. Therefore, in order to achieve a more wide range adoption of mobile Internet by digitally disadvantaged people, MNO's will have to focus on making mobile Internet more affordable to this target audience. This finding corresponds with the statement by Drego et al. (2008) that the majority of mobile Internet users indicate a reduction in cost as the primary change that will encourage and allow them to use mobile Internet more often. If the high cost of mobile Internet is only a perception of this target group, effort needs to be taken in order to address this perception and to convince these users of the opposite.

Being digitally disadvantaged also shows statistical support ($p=0.046$) for influencing the "*Context2*" variable of the research model. This implies that digitally disadvantaged consumers' use of mobile Internet is influenced by others and by advertising. This finding is echoed by Ramburn (2007) and Drego et al. (2008) who state that lack of awareness is still a major problem in the adoption of mobile Internet. Consumer education, in the form of advertising and focused marketing, is therefore something that requires urgent attention in order to improve mobile Internet adoption (Nuthall, 2008). It might also be a good idea for marketing campaigns to be specifically focused on educating the consumers about the effectiveness, efficiency and benefits offered by mobile Internet as opposed to fixed line alternatives (Ramburn, 2007). It might also be sensible for MNO's to create forums where current adopters of mobile Internet can enlighten consumers that have never used the technology about the associated benefits.

Results from this study also show that mobile Internet is digitally disadvantaged consumers' only option for accessing the Internet. As a result, these users perceive the technology to be very convenient. However, adoption of the technology by this group is restricted by a lack of knowhow. Due to this lack of technology skills and low levels of support, digitally disadvantaged people are often prevented from accessing and making use of ICT. To address this issue, MNO's can run promotional campaigns that will provide digitally disadvantaged people with the required information and knowledge to adopt mobile Internet.

The "*Digitally Disadvantaged*" variable also has a significant impact ($p=0.005$) on the "*Relative Advantage2*" variable of the research model. This implies that digitally disadvantaged users may find mobile Internet useful but also dangerous (e.g. viruses and a lack of privacy) and stressful. This corresponds with a finding by Cullen (2001) that many users of mobile Internet still express a concern about the perceived lack of security.

1.2. Does being digitally disadvantaged have a significant impact on the adoption of mobile Internet? (Research Question 2)

The data strongly suggests that being digitally disadvantaged does have a significant impact on the context, user characteristics and relative advantage constructs of the proposed research model for the MI non-user group. For consumers that have already adopted the technology, the "*Digitally Disadvantaged*" variable was found to have little impact on any of the research model's constructs.

This research project found that the "*Technological Characteristic*" variables, as suggested by Ramburn (2007), have nothing to do with whether digital disadvantage would have an impact on the adoption of mobile Internet or not.

2. Limitations

Even though the convenient, non-probability sampling approach that was followed in this research project was not fully representative of the South African population, resulting in a relatively small sample of digitally disadvantaged users, the key considerations were resource constraints and practicality.

3. Future research

Future studies may attempt to conduct similar research on a larger sample size and try to obtain a more even spread between MI users and MI non-users, and between digitally advantaged and digitally disadvantaged users. Qualitative interviews, explaining the aim of the research and research instrument, with digitally disadvantaged users and MI non-users might also result in more accurate data and a research model for which the constructs all have high homogenous loadings.

It might also be prudent for future researchers to compile a research instrument that has the same questions for both users and non-users of mobile Internet. This will result in a dataset that is more conducive to running comparisons between the two user groups.

Future studies might also investigate the impact of being digitally disadvantaged on the continued use of mobile Internet and not just the initial adoption.

7. CONCLUSION

This paper highlighted which barriers need to be addressed in order to achieve a wider adoption of mobile Internet by digitally disadvantaged people. Looking at these barriers, it is clear that all the players in South Africa's mobile industry (MNO's, SP's and WASP's) have a role to play. Even though the mobile industry has historically been one of the fastest growing markets in South Africa, consumers are still reluctant to adopt and use new services being introduced by the stakeholders in mobile data services. One possible reason for this is that telecommunication providers do not take the needs of the consumers into consideration when rolling out new services (Gilham & Van Belle, 2005; Ramburn, 2007).

From a business perspective the successful and broad based adoption of mobile Internet is critical for all the role players in South Africa's mobile industry in order to offset the capital costs associated with this new technology and to achieve the profits forecasted in their strategic plans (Lu et al., 2005). From a social perspective it is important that these barriers are overcome in order for more people to have access to the information and knowledge provided by such access. However, bridging the digital divide needs extensive commitment not only by business, but also by government in order to build infrastructure, roll out services and to ensure that literacy is developed.

This research project also highlighted the fact that being digitally disadvantaged has an impact on how people adopt mobile Internet. As a result, businesses interested in social development and aiming to increase mobile data sales among the resource-scarce but numerous South Africans living on the "wrong" side of the digital divide will do well to be aware of these factors affecting the adoption of mobile Internet. This part of South Africa's population may, in the near future, no longer be bucking the national trend, but in fact redefine it (Kreutzer, 2008).

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