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# A DESIGN SCIENCE APPROACH FOR CREATING MOBILE APPLICATIONS

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## Abstract

*In addressing competition, telecommunications operators are faced with the challenge of creating products that lure customers from their competitors and keeping their existing customers. Researchers posit that the successful implementation and wide scale adoption of mobile commerce services is best achieved by understanding consumers' attitude, interests and needs. The purpose of this study is to utilize the design science paradigm to address the creation of a mobile value-added service that meet the need of consumers and to evaluate the said service for its suitability and potential adoption in Jamaica using the Technology Acceptance Model. The results suggest that consumer interest is driven by events that are related to social experiences. The evaluation of the artifact highlighted that perceived ease of use, perceived usefulness, attitude and demographic variables, age and gender, play a role in the behaviour intention to adopt the service.*

**Keywords:** Design Science, mobile entertainment, consumer interest, Technology Acceptance Model, Mobile Commerce, Mobile Value- added Service

## **Problem Identification and Motivation**

The catalyst for liberalizing telecommunication markets worldwide was the agreement of Basic Telecommunications under the World Trade Organization in late 1990s (Kim, 2005). The agreement had a profound impact on a number of economies which resulted in the restructuring of several telecommunication industries. Within the Caribbean region the greatest impact was identified in Jamaica. According to Brown (2002) phase I of the liberalization process took effect on March 1, 2000. This phase opened the market to competition in wireless cellular services. In a publication by the Office of Utilities Regulation (2004) it was explained that since liberalization of Jamaica's telecommunications sector, the number of mobile subscribers has increased considerably from approximately 300,000 to over 1.5M in 2004. More significantly, based on recent reports by the Ministry of Industry Technology, Energy and Commerce in a document entitled "Jamaica's Telecommunications Policy 2007", at the end of 2005 Jamaica's mobile penetration rate was approximately 81%.

Similar growth has also been seen in the Korean telecommunications market. According to Kim and Shim (2007) the Korean telecommunications industry has experienced rapid development in recent years. The Ministry of Information and Communication (2005) expressed that at the end of 2005 the Korean mobile subscriber base was approximately 80%. However, in 2007, the Korean market grew by just 4.8% with an increase of only 1.1% during the first quarter (Kim and Shim, 2005). The authors noted that this stagnating rate of growth within the market suggest that it is saturated. The current level of saturation within the Korean market is considered a possible indicator of the future trends in other markets. Omnitele (2007) explained that emerging markets have a chance to learn from saturated market experiences as market evolution all over the world appears to be consistent in following an s-curve. Considering the similarities in penetration level between Jamaica and Korea, a deduction can be made that Jamaican's mobile telecommunication industry is saturated.

Saturation, aggressive market competition coupled with technologies such as Mobile Number Portability has the potential to create turbulence within a telecommunication industry (Kim and Shim, 2005). In addressing market competition telecommunications operators are faced with the challenge of creating new products to lure customers who belong to their competitors and keeping their existing customer base. The trend within the mobile industry globally is focused on the introduction of mobile data service in order to address declines in Average Revenue per user (ARPU). Mace (2007) explained that mobile operators and handset vendors in Europe and the US who are faced with the problem of saturated markets are continuously searching for new mobile data services that can drive increased ARPU. However, most of these efforts have ended in disappointment regardless of the heavy investments made. In order to preempt a decline in ARPU it is recommended that an inquiry of consumers need, habits and an evaluation of services already in the growth phase be done. In corroborating this view, Kim and Shim (2005) explained that Korean mobile carriers are becoming increasingly aware of the importance of a customer-oriented business strategy as a condition in sustaining their competitive edge. In addition, Landor (2002) posited that in order to achieve high levels of acceptance of mobile-commerce (m-commerce) it is important to be knowledgeable of consumer's need, understand consumer usage context and possess the ability to maximize Mobile Content Quality (MCQ) for customers. We therefore propose that in order to develop innovative products geared at addressing consumer needs, a design science approach be taken in the development of mobile value-added services. Loebbecke and Powell (2008) explained that design Science is concerned with creating new innovative artifacts and evaluating artifacts of technology to meet organizational needs and to investigate associated theories. The relevance of any design science research is in respect to its' constituent community. To be relevant to this community research must address the problems faced and the opportunities created by the interaction of the people within the constituents (Hevner March and Park, 2004). Based on arguments by Moore and Rutter (2004), Landor (2002) and Kim and Shim (2005) on the need for consumer centric development of products, feedback received from consumers on their interest will be used to create a mobile application which represents the artifact. The application created will then be evaluated for adoption using the Technology Acceptance Model.

The remainder of this paper will outline the purpose and significance of the research followed by an examination of the design science paradigm and its suitability for mobile value added product development, the need for a consumer centric design and a presentation of the Technology Acceptance Model as the base theory. Following the literary background and foundation the methodology will be discussed and the findings presented.

## **Objective of the Solution**

It is proposed that the lack of compelling content and limited applications are the predominant factors inhibiting the uptake of m-commerce services (Consumer Affairs Victoria, 2004). In economies such as India, the mobile subscriber base is growing at a 'scorching' pace and as ARPU for voice decreases, telecommunication providers are increasingly looking at data as an additional revenue stream (Internet and Mobile Association of India, 2006). The high density of handsets in the Jamaican mobile industry is indicative of a market which is saturated or approaching saturation. According to Mace (2007) mobile operators and handset vendors in Europe and the US faced with the problem of saturated mobile phone markets are continuously searching for new mobile data services that can drive increased ARPU. It is recommended that the successful implementation and wide-scale adoption of mobile commerce services is best achieved by understanding consumers' attitude, interests and needs (Landor, 2002; Ziv, 2005). Therefore, the purpose of this study is to utilize the design science paradigm to address the creation of a mobile value-added service that meet the need of consumers and to evaluate the said service to assess consumer perception of its suitability and potential adoption using the Technology Acceptance Model.

The design artifact at the core of this research is a mobile commerce service which has been created as a reflection of consumer's interest. The findings will be instrumental in providing a new approach to mobile product development which is intended to encourage consumer centric product creation. It is the intent that the long term results of this study will address possible declines in ARPU and advise industry on the steps to be taken to encourage market uptake of products. In addition, there is a paucity of research in the development of mobile applications using a design science approach.

## **Literature Review**

### ***Design Science***

Hevner et al (2004) outlined that behavioral science and design science are the predominant paradigms in Information Systems research. Behavioural science seeks to predict or explain human or organization behaviour while the design science paradigm seeks to extend the boundaries of human and organization capabilities by creating new and innovative artifacts. Nugrahanto and Morrison (2008) explained that generally accepted activities in design science are: Build and evaluate. Build is the process of constructing an artifact to meet specific goals while Evaluate concerns with how well they achieve the purpose. Nebeling (2007) highlighted that artifacts can be classified as constructs, models, methods, or instantiations. The products of design science are assessed against criteria of value or utility: Does it work? Is it an improvement? (Nugrahanto and Morrison, 2008)

The design science approach applied to this research is based on work presented by Hevner et al (2004). According to Hevner et al (2004) design science is a problem solving paradigm which intends to create innovations that define the ideas, practices, technical capabilities and products through which the analysis, design implementation and use of the information system can be effectively achieved. It was further conveyed that design science is not separate and apart from behavioural sciences and both should be used in unison; as truth informs design and utility informs theory. It was elaborated that design artifacts are not exempted from natural laws or behavioural theories but to the contrary their development relies on existing foundation theories that are applied, tested, modified and extended through factors such as experiences, creativity, intuition and problem solving capacities of the researcher (Hevner et al, 2004). The importance of the interaction between behavioural science and design science has been carefully considered for this research, using the design science research guideline presented by Hevner et al (2004) the present research has been sculpted to illustrate the importance of this approach in developing mobile products ( see table 1). It is important to note that the prior discussions presented in this research paper have addressed guidelines two and four of the design science process presented by Hevner et al (2004). The other guidelines will be addressed in the proceeding sections.

<b>Table 1. Design- Science Research Guidelines</b>	
<b>Guideline</b>	<b>Description</b>
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method or an instantiation.
Guideline 2: Problem Relevance	The objective of design science research is to develop technology-based solutions to important and relevant business problems
Guideline 3: Design Evaluation	The utility, quality and efficacy of a design artifact must be rigorously demonstrated via well executed evaluation methods.
Guideline 4: Research Contribution	Effective design science must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and or design methodologies.
Guideline 5: Research Rigor	Design science research relies upon the application of rigors methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment
Guideline 7: Communication of Research	Design Science research must be presented effectively both to the technology- oriented as well as management- oriented audiences.

Adopted from: Hevner March and Park (2004)

### ***User Perception and Value- Added Content Creation***

Design science scholars posit that it is imperative that heuristic search strategies be utilized to produce feasible good designs that can be implemented in the business environment. Hevner et al (2004) stated that design is a search process to discover an effective solution to a problem. In addition problem solving can be viewed as the utilization of available means to reach desired ends while satisfying laws existing in the environment. To address the design as a search process this research takes advantage of a consumer centric approach in the development of the desired artifact. The views expressed by researchers on the creation of mobile data services have been consistent. The general stance taken is centered on the creation of services based on consumer perspective. Moore and Rutter (2004) suggested that in order to establish mobile service interest groups and communities, the mobile entertainment industry should explore the needs and interests of a range of potential users. Landor (2002) posited that in order to achieve high levels of acceptance of m-commerce it is important to be knowledgeable of consumer's need, understand consumer usage context and possess the ability to maximize Mobile Content Quality (MCQ) for customers. The importance of incorporating the user's perspective in creating a marketable end-product is also emphasized by other scholars who believed that a consumer oriented approach is the key to mass market adoption. Ziv (2005) explained that in earlier years of mobile platform development, the emphasis was completely placed on technology and not end users. Ziv criticized the linear approach in which mobile carriers dictate terms of innovation and development to content providers and users. Ziv suggested a more ecological approach in which content providers, technology companies and users of the platform all play an important role. According to Anckar and D'Incau (2002) several companies have invested in projects from a 'technocist focus', which means they have neglected the consumer perspective during development and this approach has resulted in the failure of projects. According to Sun, Su and Ju (2005) the need to evaluate different opinions on value-added services lies in the possibility that one group may have a high opinion of a specific value-added service feature, whereas another group may completely reject this value-added offering.

The ideas expressed by Anckar and D'Incau (2002), Clarke (2001), Sun et al (2005) and Landor (2002) are all similar. All authors agreed that in order for m-commerce to be successful, Mobile Content Quality must be carefully examined in the presentation of services. The result of work conducted by Landor (2002) indicated that media that add value to the user will be the most successful within the market. It should therefore be reiterated that mobile users should have a say in the types of services brought to the market as this is consistent with good product development and marketing.

### **Consumer Interest Frameworks**

The notion of using the consumer perspective to develop applications has led researchers such as Anckar and D’Incau (2002) and Clarke (2001) to develop frameworks and guidelines that address the issue of consumer needs. Clarke (2001) proposed that the relationship between consumers and suppliers in the wireless environment should be viewed from a value proposition standpoint. Clarke (2001) defined the value proposition for mobile commerce within four (4) categories.

- **Ubiquity:** Mobile devices allow users to receive information and perform transactions from any location on a real-time basis. The question here is, what value offering will be provided everywhere at the same time?
- **Personalization:** The personalization of messages based on time and location for specific users. The issue that needs to be evaluated within this category is, what individual based target market can be employed?
- **Localization:** Location specific information focuses on the supply of information relative to the current geographic location of the user. Developers should evaluate, what location-based marketing strategies can be offered?
- **Convenience:** The ability to access information and services without the constraints and limitations of wired infrastructure. The area of focus within this category is what factors create time and space utility?

Sun et al (2005) utilized Clarke’s value proposition framework to examine numerous mobile commerce services (gaming, email, transportation, video, music, travel etc.) offered in Taiwan and China. The findings from the study suggested that each category of mobile commerce is characterized by a diverse combination of value proposition attributes. However, based on results obtained the authors concluded that value-added service tendency is largely driven by entertainment as these services were highlighted in the study as having the most value. An examination of the impact of value-added characteristics on mobile consumer interest was also conducted by Clarke (Anckar and D’Incau (2002)). The researchers proposed an analytical framework that can be used to evaluate the suitability of applications for m-commerce. The framework consists of two components, namely wireless-value and mobile-value. The wireless-value is defined as the value which arises when using unwired devices for example, a Laptop or a Personal Digital Assistant (PDA). On the other hand, mobile-value is defined as the value arising from the mobility of the new medium, for example, making an Internet connection with a PDA. Mobile-value is broken down in the following areas:

- **Time-critical arrangements:** Time-critical situations arise from external events, which mean that the always-on connectivity of the medium is an important feature, for example, alerts for stock traders.
- **Spontaneous decisions and needs:** These needs are related to products and services that are characterized by the purchasing decision being straightforward, that is they do not require careful consideration. Spontaneous needs can also be entertainment-related, efficiency-related or even time critical in nature.
- **Entertainment needs:** These needs are centered on killing time/having fun, especially in situations where there is no access to wired entertainment appliances. Entertainment needs are generally also spontaneous in character, especially in mobile settings.
- **Efficiency ambitions:** These applications are aimed at productivity, for example, electronic planners
- **Mobile situations:** These services are valuable only through a mobile medium, as needs for these services predominantly arise when away from home for example, in the use of vending machine to make payments

The results of the study carried out by Anckar and D’Incau (2002) indicated that services offering mobile-value on several dimensions proved to be more interesting than services that offer one dimension of mobile-value. The major similarity between Clarke’s and Anckar and D’Incau’s framework is the use of both approaches to measure value-added characteristics of mobile commerce services. Su et al (2005) utilized Clarke’s framework to examine what were the predominant value-added characteristics found in services offered by companies in Taiwan, while Anckar and D’Incau (2002) evaluated the specific value-added characteristics observed in consumer interest in potential mobile services to be offered in Finland. However based on the constructs of Clarke’s framework it was observed that Anckar and D’Incau’s framework was more specific in explaining value-added characteristics of services. The components of Clarke’s framework are general and provide limited insight into consumer interest. In addition, the approach used by Anckar and D’Incau is similar to the one which is employed in this research in ascertaining mobile consumer interest within the Jamaica mobile market. Based on the differences, Anckar and D’Incau (2002)

framework is considered as the most suitable framework for evaluation consumer interest in proposed mobile data services in Jamaica. Therefore, this research will use Anckar and D’Incau’s framework to evaluate the results of the current study.

### ***Base Theory***

Hevner et al (2004) argued that design science and behavioral science informs and challenges each other for example the technology acceptance model (TAM) challenges design science researchers to create artifacts that enable organizations to overcome the acceptance problems predicted. It was further conveyed that the utility, quality and efficacy of a design artifact must be rigorously demonstrated via well- executed evaluation methods. It is recommended that IT artifacts can be evaluated in terms of functionality, completeness, consistency, accuracy, performance, reliability, usability and other relevant quality attributes. Considering these recommendations put forward by Hevner et al (2004) TAM will be used as the based theory in assessing behavioral factors associated with the adoption of the artifact created. According to Pikkarainen, Pikkarainen, Karjaluoto, and Pahlila (2004) TAM is one of the most utilized models in studying information system acceptance. Succi and Walter (1999) explained that TAM is an information systems theory that models how users accept and use a technology. Saljoughi (2002) highlighted that TAM was developed by Davis (1986) based on the theoretical premise of the Theory of Reasoned Action (TRA) which was created by Fishbein and Ajzen (1975). TRA explains the process of adopting an innovation. Building on the principles of the TRA, Davis (1986) explained that TAM consists of two key factors that determine user acceptance: perceived usefulness and perceived ease of use. These are:

- **Perceived usefulness (PU)** explains the degree to which a person believes that using a particular system will enhance his or her job performance. Lee and Jun (2005) pointed out that according to evidence presented by Davis (1989), PU has a significant effect on a person’s behavioral intention.
- **Perceived ease-of-use (PEOU)** defines the degree to which a person believes that using a particular system will be free from effort. According to Lee and Jun (2005) additional research done on TAM after the model was coined by Davis (1986) indicated that PEOU has a positive effect on PU.

We therefore posit:

H<sub>1</sub>: Perceived ease of use will have a positive effect on perceived usefulness of the mobile entertainment service

H<sub>2</sub>: Perceived usefulness will have a positive impact on consumer’s behavior intention to use the mobile entertainment service

The ideas expressed by scholars on the importance of the attitude construct within TAM vary. According to Istheory (2006) researchers have simplified TAM by removing the attitude construct found in TRA. Making reference to Venkatesh and Davis (2000), Wedderburn (2005) explained that it has been demonstrated that the explanatory power of TAM is just as good without the attitude construct. Sandberg and Wahlberg (2005) defined attitude as an implicit, drive-producing response considered socially significant in the individual’s society. Malhotra and Galletta (1999) explained that attitude (A) and PU influence the individual’s behavior intention (BI) to use the system. However, actual use of the system is predicted by BI of the user. The researchers assert that the issue of users buying into new information technologies is based on internalization of usage that is embedded in users’ attitudes. According to Pikkarainen et al (2004) the underlining principles of TAM have been tested in many studies and it was found that TAM’s ability to explain users’ attitude towards using an information system is more reliable than other models of the same nature. We therefore posit that:

- H<sub>3</sub>: Consumers’ attitude will have a positive effect on their behavior intention to use the mobile entertainment service
- H<sub>4</sub>: Perceived ease of use will have a positive effect on consumers’ attitude towards using the mobile entertainment service

According to Pederson (2001), Methlie and Thorbjørnsen (2002) when compared to the Theory of Planned Behavior (TPB) model, TAM lacks sufficient consideration of the importance of expectations. They emphasized that for services with strong social network effects, the importance of expectations should not be taken slightly. According to Lopez and Manson (1997) social influences play an important role in the prediction of IT usage. Pederson (2001) noted that subjective norms should be determined by external and interpersonal influence. They added that subjective norms capture the individual’s perceptions of the influence of significant others such as family, peers, authority figures, and media. Khalifa and Shennd (2006) highlighted that subjective norms have been identified as a

major predictor for perceived usefulness and suggested that the direct effect of subjective norms on perceived usefulness is realized through the internalization process in which people incorporate the important referents' opinions into their own belief structure, especially when usage is voluntary. We therefore posit:

- H<sub>5</sub>: Subjective Norms will have a positive effect on consumers' behavior intention to use the mobile entertainment service

According to Venkatesh et al (2003), age and gender have received very little attention in the technology acceptance research literature. It has been observed that TAM significantly lacks any explanation on demographic factors that may play a role in the adoption of technologies. With this in mind contextualizing the model to incorporate these factors may prove useful to telecommunication providers in tailoring applications for a specific market. Considering the criticisms previously discussed, it is proposed that demographic variables such as age and gender be used to modify TAM with the intention to create a model that provides specific explanations on the moderating effect of demographic variables on the relationship between perceived ease of use, perceived usefulness and attitude towards using the technology.

Hubona (2008) explained that except for Agarwal and Prasad (1999) who concluded that the belief constructs do not fully mediate the effects of the external variable, age; this effect has not been tested. Lee Kozar and Larzen (2003) asserted that the moderating effects of variables such as culture, gender, task, and user type need to be examined as they relate to TAM. The authors also pointed out that gender was fairly evenly distributed across TAM studies; however there was no mention of age. Vekatesh et al (2003) explained that the complex nature of the interactions observed for both gender and age gives rise to the need for more investigation to be done with these variables especially in today's workforce environment. It must be noted that although the use of demographic variables by Venkatesh et al (2003) was done within the framework of a working environment, for the purpose of this research these demographic constructs will be applied to the mobile environment. Looking at these variables in the mobile environment is in line with the views of Venkatesh et al (2003) as the researchers pointed out that there is a need to enhance our understanding of technology usage by examining newer applications and attempting to account for variances in usage behaviour. Given the shortcomings identified with TAM in the literature, it is proposed that TAM be modified with the moderating demographic factors age and gender and that by incorporating these factors into TAM further insight will be provided on the role demographics play in consumers' intention to use a system (see figure 1 for research model). We therefore posit:

- H<sub>6</sub>: Gender will moderate the effect of perceived usefulness on the behaviour intention to use the mobile entertainment service
- H<sub>7</sub>: Age will moderate the effect of perceived usefulness on the behaviour intention to use the mobile entertainment service
- H<sub>8</sub>: Gender will moderate the effect of perceived ease of use on the behaviour intention to use the mobile entertainment service
- H<sub>9</sub>: Age will moderate the effect of perceived ease of use on the behaviour intention to use the mobile entertainment service

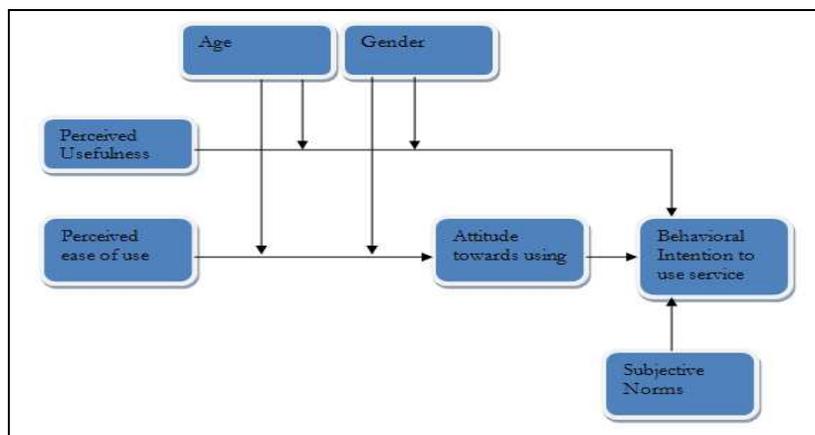


Figure 1. Research Model

## Methodology

### *Design as an Artifact*

It is integral that a design science research produces a viable artifact in the form of a model, construct, a method or instantiation (Hevner et al, 2004). Nugrahanto and Morrison (2008) explained that generally accepted activities in design science are: Build and Evaluate. Build is the process of constructing an artifact to meet specific goals while evaluate is concerned with how well the purpose is achieved. Hevner et al (2004) explained that creating an instantiation is a proof by construction. In achieving this proof for the current research, prior to building the artifact a quantitative research was carried out to determine which one of the following nine (9) mobile commerce applications is most desired by consumers (see Table 2). This approach is consistent with the literature previously discussed which highlighted the importance of using a consumer centric approach in creating mobile applications. The selection of these services was done based on the listing of proposed services sampled by Anckar and D’Incau’s (2002) in Finland. However, the specific nature and features offered in each service was based on traditional service offerings in Jamaica

<b>Table2. Definition of services</b>	
<b>Service</b>	<b>Definition</b>
Viewing Newspaper Headlines	A service which allows a user to log on to a wireless site and view information on current local and regional news headlines.
Compare Car Prices Online	A service which allows a user to visit a wireless site and check the prices of automobiles which are offered by different local automotive providers.
Previewing Music from Local Artistes	Previewing music from local reggae, gospel and soca artistes is a service which allows a user to download snippets of songs selected from the most recently released local albums.
Preview Movies from Carib/ Palace Amusement	A service which allows users to download and preview movie snippets from a local cinema.
Check Grocery Prices	A service which allows users to view current grocery prices on a wireless site.
Mobile School’s Challenge Quiz (MSCQ)	School’s challenge quiz is a game show which is broadcasted on one of Jamaica’s television stations. The game show has recently gained the status as the longest running local television show in the Caribbean. The main purpose of School’s Challenge Quiz is to provide a platform for various high schools in Jamaica to compete academically. Therefore Mobile School’s Challenge Quiz is a game which simulates the quiz show on the handset for a stand alone user. The game will focus on different subject areas with varying levels of difficulty.
Checking Information on Parties/Clubbing	A service which allows a user to log on to a wireless website and view information on upcoming social events.
Playing a Game that Predicts the Lottery	A service which generates possible lottery numbers for the upcoming lottery draw.
Playing the Lottery	A service which allows users to purchase their lottery tickets via text messaging.

According to Van de Kar (2005) one of the main reasons for companies reviewing the market for new products within the mobile telecommunications industry is to become and to remain competitive in the future. Kar et al (2003) explained that technology is the enabling factor for the development of new services; however a service which is driven solely by technology will not be successful in the mobile market. The researchers pointed out that the value to be delivered to the consumer, taking into consideration their context usage, is essential to drive the success of new services within the market. Based on these arguments this phase of the research was considered as fundamental to delivering a product to a market which is based on consumer perspective.

A questionnaire consisting of close-ended questions on a five point Likert type scale (5-very interested, 4-interested, 3-neutral, 2- little interest, 1-no interest) was used to collect the data. Similar to the instrument used by Anckar and

D’Incau’s (2002), respondents were instructed to indicate their level of interest in the proposed mobile commerce services. Three hundred (300) questionnaires were issued and two hundred and ninety-six (296) were returned. Of the returned questionnaires, two hundred and seventy-six (276) were usable and twenty (20) were unusable. The unusable questionnaires were as a result of twelve (12) incomplete questionnaires and eight (8) questionnaires with inconsistencies. All items used on the questionnaire were adopted from Anckar and D’Incau’s (2002) research. However, to ensure reliability of the measures used to capture consumer interest in the services named above a Cronbach’s Alpha test was done. Pikkarainen et al (2004) pointed out that acceptable value of Cronbach’s alpha can vary between 0.5 and 0.95, however an acceptable value of Cronbach’s alpha for basic research should be higher than 0.7. It should be noted that the Cronbach’s alpha value for the items tested was .823. Based on the results of the Cronbach’s alpha test the measure used to capture consumer interest have a reliable Cronbach’s alpha score which suggest that the values show good internal consistency among scales employed for the present study. The results of the survey are used to create the artifact using several open source technologies (Apache, Wireless Application Protocol (WAP), Hypertext Pre-processor (PHP) and My Structured Query Language (MySQL)). A mobile entertainment service was developed based on participants’ indication of the most favoured application.

### ***Evaluation of the Artifact***

Following the development of the artifact, a second survey was carried out to evaluate the adoption of the artifact and the results were analyzed using SPSS software. The sample selected did not overlap with the previous sample selected to assess consumer interest. The research model was tested among a group of one hundred and fifty-nine (159) participants and the data were collected using a questionnaire. Participants were randomly chosen and allowed to interact with the application developed and then were probed on their experience with the service and their interest in using this service in the future. In an effort to encourage honest responses, participants were allowed to remain anonymous. The survey instrument was adopted from instruments created by Pikkarainen, Pikkarainen, Karjaluoto, and Pahlila, (2004), Anckar, Carlsson and Walden (2003), and Malhotra and Galletta (1999). The validity of the instrument was tested using the Cronbach’s alpha test. The following results depict the Cronbach’s alpha values obtained for the different constructs tested:

- Perceived Ease of Use: ( $\alpha = .819$ )
- Perceived Usefulness: ( $\alpha = .826$ )
- Subjective Norms: ( $\alpha = .827$ )
- Attitude: ( $\alpha = .856$ )

## **Demonstration and Findings**

### ***Creating the Artifact***

The findings showed that the online game MSCQ, previewing music from local artistes and previewing movies from the cinema were identified as the top three most desired data services. A majority, one hundred and eighty-one (181) or (65.6%) of the respondents indicated that they were either interested or very interested in playing MSCQ on their handsets. However, it should be noted that the mean score for mobile school’s challenge quiz was the second highest with a value of 3.67 (see Table 3). On the other hand previewing music from local artistes had the highest mean score of 3.73 but a slightly lower percentage of 64.5% of respondents expressed a desire to use the service. Previewing movies from the cinema was chosen as the third most desired service among the respondents as 63.4% of the respondents’ indicated that they were interested in this data service (see Table 3 for mean score). The framework created by Anckar and D’Incau (2002) was used to evaluate the results of the survey on consumer interest. It indicated that although the Jamaican market has an interest in services which satisfy spontaneous and entertainment needs, for example previewing music and previewing movies, services such as MSCQ which has an additional mobile value offering such as ‘efficiency ambitious’ was considered as more appealing to consumers.

The mobile application selected as the artifact for creation is MSCQ. Due to the marginal difference between the interest in MSCQ and previewing music, the selection for the creation of the artifact was done based the findings as well as literature. It is believed that one of the motivations of consumer interest in MSCQ is driven by the association of the mobile service with the actual School’s Challenge Quiz television programme. This view is supported by the ITU (2006) which articulated that in the mobile world content is being driven primarily by events or brands unrelated to telecommunications operators such as a popular television series. It was further explained

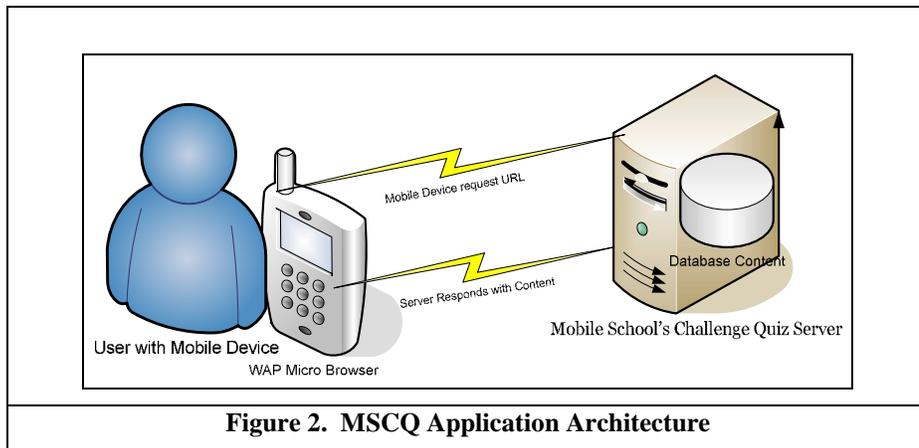
that as the mobile industry evolves, consumer interest will change and that video and audio content will become the preferred services. In addition, it was also suggested that following digital music, gaming and gambling are predicted to be the next big drivers of mobile services (ITU, 2006). Based on the findings of the current study it can be argued that consumer interest in Jamaica’s mobile industry is in line with predictions made by the ITU.

Table 3. Comparison of Services						
	TC	S	EN	EF	Mean	Percentage Interested or very interested
Mobile School's Challenge Quiz (MSCQ)		*	*	*	3.6703	65.6%
Preview Music		*	*		3.7283	64.5%
Preview Movies from the cinema		*	*		3.6486	63.4%
Newspaper Headlines	*	*	*	*	3.4819	57.3%
Compare Car Prices		*		*	3.2391	51.9%
Check Grocery prices		*		*	3.1449	47.8%
Information on parties		*	*		3.1232	46.3%
Play Lottery		*	*		2.3333	31.5%
Lottery Game		*	*		2.4710	27.9%
<b>TC- Time Critical, S-Spontaneous Needs, EN- Entertainment Needs, EF – Efficiency Ambitious</b>						

MSCQ is classified as an online educational game. Researchers such as Antonellis, Bouras and Pouloupoulos (2005), Facerw, Joiner, Stanton and Reidz, Hullz and Kirk (2004) argued that educational gaming is the future of mobile gaming. These researchers advocate that game-based learning has been studied as an important alternative or supplement to traditional teaching. In addition, mobile technologies offer the opportunity to embed learning in a natural environment. It was suggested by Maniar and Bennett (2001) that “games potentially provide an excellent learning environment because they motivate a person and hold their attention” (p.1). In addition, Schwabe and Goth (2005) reported that in a study conducted by Lepper and Cordova (1992) experiments revealed that computer games raise the efficiency of learning if they increase the intrinsic motivation and link the ‘winning of the game’ and ‘learning the material’. This clearly adds value to the mobile experience which is the core of developing any mobile commerce application. Based on these arguments supporting game-based learning, Mobile School’s Challenge Quiz is considered as an appropriate service for development.

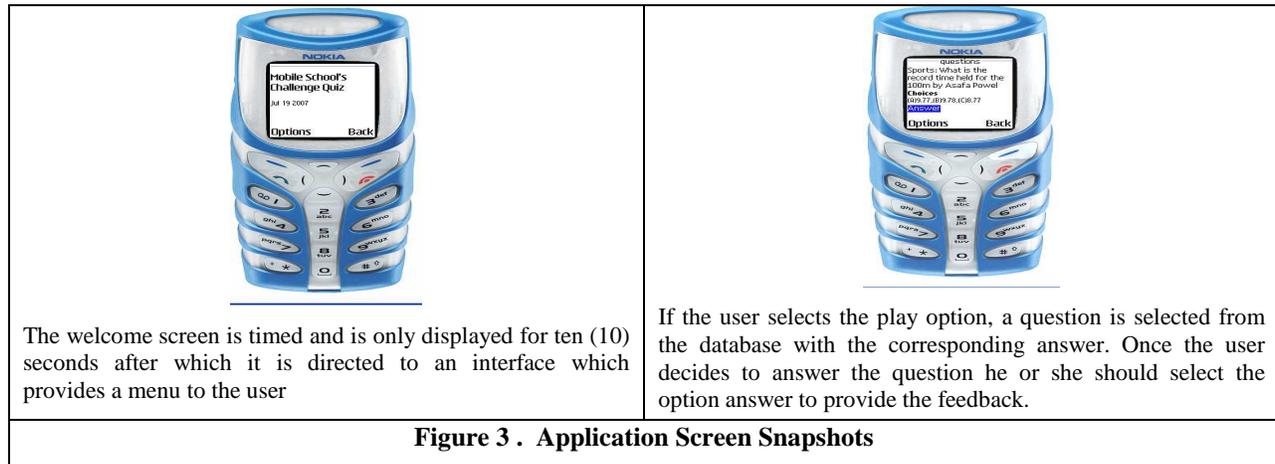
**Mobile School’s Challenge Quiz Application**

This section describes the functionality of the Mobile School’s Challenge Quiz application and presents an over view of the architecture created for the service (see Figure 2). The application architecture consists of two main components: a server with a MySQL database that stores questions on the various subject areas for the electronic quiz and a WAP web page which provides the user with the interface on their mobile device to interact with the server.



**Figure 2. MSCQ Application Architecture**

In order to interact with the mobile game, the user must first enter the Uniform Resource Locator (URL) for the application on the mobile device. Once the request is resolved the user is then given access to the wireless site. A welcome page is displayed to the user once access is granted (see Figure 3).



**Evaluating the Artifact**

**Consumer Behaviour Intentions**

The results of a sequential multiple regression analysis suggested that there was a good correlation (R) of .747 between respondents’ intention to use MSCQ and their attitude towards the service (see Table 4).

**Table4. Assessing Predictors of Behaviour Intention**

Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate	Sig.
1	.747(a)	.559	.556z		2.61609	.000
2	.798(b)	.638	.633		2.37803	.000
3	.818(c)	.669	.663		2.27964	.000

- a. Predictors: (Constant), attitude
- b. Predictors: (Constant), attitude, PU\_GENDER
- c. Predictors: (Constant), attitude, PU\_GENDER, PU\_AGE

The correlation value also showed that there was a positive relationship between respondents’ intention to use and their attitude towards the service. The results of the R square value suggested that attitude explains 55.9% of the variance in respondents’ intention to use the mobile service. Considering these results and a p-value of .000 there is a significant relationship between consumer’s attitude and intention to use the ME service. The predictive power of model 1 is as follows: Intention = -.690+ .642 (attitude). This implies that an increase in positive attitude results in an increase in the intention to use the technology (see Table 5). Therefore the following Hypothesis is accepted: H<sub>3</sub>: Consumer Attitude towards using will have a positive effect on their behaviour intention to use the mobile service.

**Table5. Significance Assessment of Predictors of Behaviour Intention**

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	-.690	1.009		-.684	.495
Attitude	.642	.046	.747	14.093	.000
2 (Constant)	-.690	.917		-.664	.508
Attitude	.514	.047	.598	10.952	.000
PU_GENDER	.174	.030	.318	5.832	.000
3 (Constant)	-1.946	.946		-2.058	.041
Attitude	.526	.045	.612	11.671	.000

PU_GENDER	.154	.029	.280	5.265	.000
PU_AGE	.050	.013	.181	3.842	.000

In the second step of the regression analysis, the moderating effect of gender on the predicted path of perceived usefulness on behaviour intention was introduced. The addition of the moderating variable increased the fit of the model. The results highlighted that there was a very good correlation (R) of .798 between respondents' intention to use MSCQ and their attitude towards the service and the moderating effect of gender (see Table 4). The results of the R Square value suggested that attitude and PU\_GENDER explains 63.8% of the variance in respondent's intention to use the mobile service with a p-value of .000. The predictive power of model 2 is as follows: Intention = .690 + .514 (attitude) + .174 (PU\_GENDER). This implies that an increase in positive attitude and the effect of the moderating variable gender results in an increase in the intention to use the technology (see Table 5). Therefore, the following hypothesis is accepted: H<sub>6</sub>: Gender will moderate the effect of perceived usefulness on the behaviour intention to use the mobile entertainment service

In the third step of the regression analysis the moderating effects of age on the predicted path of perceived usefulness on behaviour intention was introduced. The addition of the moderating variable increased the fit of the model. The results highlighted that there was a very good correlation (R) of .818 between respondents' intention to use MSCQ and their attitude towards the service and the moderating effect of age (see Table 4). The results of the R Square value suggested that attitude and PU\_AGE explains 63.8% of the variance in respondents' intention to use the mobile service with a p-value of .000. The predictive power of the model is as follows: Intention = -1.9456 + .514(attitude) + .154 (PU\_GENDER) + .050 (PU\_AGE). This suggests that an increase in positive attitude and the effect of moderating variables age and gender results in an increase in the intention to use the mobile service (see Table 5). The following hypothesis is accepted: H<sub>7</sub>: Age will moderate the effect of perceived usefulness on the behaviour intention to use the mobile entertainment service

**Consumer Attitude**

The results of the sequential multiple regression analysis suggested that there was a poor correlation (R) of .348 between perceived ease of use of MSCQ and their attitude towards the service (see Table 6).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig.
1	.348(a)	.121	.115	4.29747	.000
2	.510(b)	.260	.251	3.95474	.000

a. Predictors: (Constant), Perceivedeaseofuse

b. Predictors: (Constant), Perceivedeaseofuse, PEU\_AGE

The results depicted a positive attitude relationship between respondents' attitude and the perceived ease of use of MSCQ. The results of the R square value suggested that perceived ease of use represented a small variance of 12.1% in respondents' attitude towards using the mobile service with a p-value of .000. Based on the results there is a significant relationship between perceived ease of use and respondents' attitude. The predictive power of model 1 is as follows: Attitude = 13.140 + .528 (perceived ease of use). This implies that an increase in perceived ease of use of the service results in an increase in positive attitudes to use the service (see Table 7). The following hypothesis is accepted: H<sub>4</sub>: Perceived ease of use will have a positive effect on consumers' attitude towards using the mobile entertainment service.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	13.140	1.868		7.033	.000
Perceivedeaseofuse	.528	.113	.348	4.649	.000
2 (Constant)	14.019	1.727		8.118	.000
Perceivedeaseofuse	.682	.108	.450	6.299	.000
PU_AGE	-.079	.015	-.387	-5.421	.000

In the second step of the regression analysis the moderating effect of age on the predicted path of perceived ease of use on attitude was introduced. The addition of the moderating variable increased the fit of the model. The results highlighted that there was a good correlation (R) of .510 between the perceived ease of use of MSCQ and respondents attitude towards the service and the moderating effect of age (see table 6). The results of the R Square value suggested that perceived ease of use and PU\_AGE explains 26% of the variance in respondent’s attitude towards the mobile service with a p-value of .000. Considering the results the following hypothesis is accepted: H<sub>8</sub>: Age will moderate the effect of perceived ease of use on consumers’ attitude to use the mobile entertainment service. The predictive power of model 2 is as follows: Attitude = 14.019 + .682(Perceived ease of use) – .079(PU\_AGE). This suggests that an increase in perceived usefulness of the service results in an increase in positive attitudes to use the service; however, an increase in the moderating variable age results in a decrease in the positive attitude towards the service (see Table 7). Based on the results the following hypothesis is accepted: H<sub>9</sub>: Perceived ease of use will have a positive effect on consumers’ attitude towards using the mobile entertainment service

**Perceived Usefulness**

The results showed that there was a relatively good correlation (R) of .546 between perceived ease of use and perceived usefulness with a significance of .000 (see table 8).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig.
1	.546(a)	.298	.293	2.52757	.000

a Predictors: (Constant), Perceivedeaseofuse

The correlation value also showed that there was a positive relationship between perceived ease of use and perceived usefulness. The results of the R Square value suggested that perceived ease of use explains 29.8% of the variance in perceived usefulness (see table 8). Therefore the following hypothesis is accepted: H<sub>1</sub>: Perceived ease of use will have a positive effect on perceived usefulness of the mobile entertainment service.

**Discussion**

***Creating the Artifact***

The findings of the current study suggest that games, audio and news services were selected by participants as three main areas of interest. Contrary to the findings of the current study, a research conducted by Anckar and D’Incau (2002) suggested that persons in Finland had a very low willingness to use commonly hypothesized “killer applications” such as online gaming, music and news services. The authors considered these findings particularly alarming as these applications are considered as services which will acquire high consumer interest. In contrast to Anckar and D’Incau’s findings, the results of this current study suggest that hypothesized killer applications such as online gaming, music and news services were rated among the top four services of interest to the Jamaican consumer. The results of Anckar and D’Incau’s study showed that when compared to the results of this research the mean score for online gaming, music and news services was relatively low (see Table 9). It should be noted that a five point Likert type scale was used in both studies).

Service	Mean Score of study	Anckar and D’Incau mean score
Online Game	3.65	2.14
Music	3.73	2.46
News Services	3.48	2.77

Anckar and D’Incau (2002) attributed the low level of interest in these services to the fact that the majority of the services surveyed had not actually been used by consumers. However, based on the results obtained from the current

study and the fact that none of the services surveyed among Jamaican consumers have ever been used before. It is proposed that the difference in interest identified in both studies may be attributed to a difference in culture or other unknown factors. The possibility of culture being an underlining factor in explaining difference in consumer interest has also been suggested by Pikula (2001). The author proposed that the success of mobile data services in Japan can be largely attributed to the cultural uniqueness of the country in comparison to the United States and other western societies. The author explained that the Japanese consumer market is more homogeneous compared to Western markets which lead to a high “me-too” factor and high adoption rates. In addition, Japanese people travel long hours on trains every day, whereas people in America use cars mostly. Pikula (2001) explain that this would imply that, to kill time while aboard these trains, Japanese people tend to use mobile internet services more often.

It is believed that one of the motivations of consumer interest in MSCQ is driven by the association of the mobile service with the actual School’s Challenge Quiz television programme. This view is supported by the ITU (2006) which articulated that in the mobile world, content is being driven primarily by events or brands unrelated to telecommunications operators such as a popular television series. It was further explained that as the mobile industry evolves, consumer interest will change and that video and audio content will become the preferred services. In addition, it was also suggested that following digital music, gaming and gambling are predicted to be the next big drivers of mobile services (ITU, 2006). Based on the findings of the current study it can be argued that consumer interest in Jamaica’s mobile industry is in line with predictions made by the ITU

### ***Evaluating the Artifact***

According to Han (2002) if the adoption process of mobile services is understood it will provide the industry with the ability to predict consumer behavior and industry trends. The sentiments expressed by Han (2002) are the primary motivation for assessing consumer’s intention to adopt a mobile entertainment application in Jamaica using the TAM with demographic modifications. From the results of the current study perceived usefulness, perceived ease of use, attitude, gender and age played a role in explaining consumers’ intention to use MSCQ. The present study reports findings similar to Yang (2004) in that perceived usefulness was identified as a good indicator of consumers’ intentions to use MSCQ in the model. The results of the current study suggest that consumers’ intention to use MSCQ can be largely attributed to the perceived usefulness of MSCQ. In a similar study conducted by Khalifa and Shen (2006) on the adoption of mobile commerce services, perceived usefulness explained 69.2% of consumers’ intention to use mobile data services. Yang (2004) elaborated that in order to accelerate the diffusion process it is essential to increase consumers’ perceived usefulness of MC by emphasizing the importance of the technology in users’ daily life as increasing perceived usefulness will lead to increase perceived ease of use and ultimately to higher intention to adopt MC. This recommendation is considered as a fundamental criterion for the adoption of data services in the local mobile industry and should be considered by the Jamaican telecommunication sector.

According to Pikkarainen et al (2004) users become more aware of the perceived ease of use of a technology, as it becomes more significant. Additionally, research carried out by Lee and Jun (2005) and Cyr, Head and Ivanov (2006) have indicated that perceived ease of use has a positive effect on perceived usefulness, which in turn significantly impacts adoption. The results obtained from the evaluation of TAM in the present study corroborate this view as perceived ease of use explained 29.8% of the variance in perceived usefulness. The impact of perceived ease of use on perceived usefulness was also evident in a study conducted by Liu and Ma (2006) which reported that perceived ease of use explained 21% of the variance in perceived usefulness. Based on the effect of perceived ease of use on MSCQ it is suggested that the creation of future mobile data services locally should adhere to proper Human Computer Interaction (HCI) principles for development.

Although attitude is considered by numerous researchers as a construct which does not play an important role in TAM, the results of this current research do not support this and in fact indicates otherwise. From the results attitude was found to be the most powerful predictor within the model. The results showed that attitude, had a very strong correlation of .747 with intention to use the technology. It should be noted that there was a positive relationship between the two variables suggests that as persons’ attitude become more positive their intention to use the ME service also increases. The significant relationship identified between the two constructs is consistent with Schaper and Pervan (2004) who explained that attitude was also found to be a direct predictor of behavioural intent in nursing staff and other areas of health care. It is recommended that in order to capitalize on the role attitude plays in the adoption of data services, effective marketing should be employed which targets specific user groups. Sharma

(2007) explained that the days of mass market advertising and marketing are numbered and marketers should design and create offerings customized to the specific needs of consumers.

Demographic factors have been excluded from a majority of technology acceptance studies but it has recently garnered the attention of researchers as an area which requires evaluation. According to Yang (2004) past TAM studies hypothesized that demographics will moderate consumer adoption of new Information Communication Technologies by influencing consumers' perceived usefulness and perceived ease of use. The results of a study conducted by Venkatesh et al (2003) suggested that the variables gender and age play a role in the acceptance of information technology in the work environment. In support of the findings of Venkatesh et al (2003), Yang (2004) pointed out that Pijpers et al. (2001) found that age plays a significant role in person's intention to adopt a technology. Pijpers's et al. results suggested that age is negatively related to perceived usefulness and perceived ease of use. On the other hand, Yang's (2004) findings provided mixed results with age positively predicting consumers perceived usefulness, but not their perceived ease of use.

The results of the current study to some extent corroborate the findings of Pijpers et al. (2001) as age moderated the relationship between perceived usefulness and behaviour intention. In addition age also had a moderating effect on the relationship between perceived ease of use and attitude. The role of age within the model is considered significant and provides evidence to suggest that the mobile industry should consider this variable as a key to the development of services similar to MSCQ. However, based on mixed results from previous studies, closer attention should be paid to age as a demographic factor in technology acceptance model. Citing Venkatesh et al (2003), Yang (2004) explained that gender has attracted researchers' attention to examine its effect on adoption decision. According to Yang (2004), Pijpers et al. (2001) hypothesized that males are more positive than females in their perception of MC. However, Yang (2004) claimed that empirical data suggest that there is a significant, but negative, relationship in gender- perceived usefulness and gender-perceived ease of use. The results derived from this current study in the assessment of gender in the acceptance of MSCQ suggest that gender plays a role in moderating the relationship between perceived usefulness and behaviour intention

In summary, the results of the research suggest that TAM is an effective model in explaining consumers' intention to use MSCQ. The extension of the model with demographic factors provided more insight into the role of age in explaining the adoption of the service. The results showed that gender was statistically significant in the model which has provided insight on the possible effect of this model extension. Age also had an explanatory power in the model.

## **Communication of research**

According to Hevner et al (2002) companies spend billions of dollars a year on IT and often times they realize that investments have been wasted. To this avail it was suggested that effective artifacts that address these problems will be welcomed. The primary objective of the research was to address this issue within the telecommunications industry by utilizing a design science approach in the development of a mobile value-added service. The results of this study suggest that local consumer interest is consistent with predictions of the International Communication Union. It is recommended that the rolling out of consumer value-added services in the Jamaican mobile industry should be informed by the results of this study. It is evident that presently mobile consumer interest in Jamaica is been driven by events that are related to social experiences, such as MSCQ. The utility provided by the artifact created includes satisfying spontaneous needs, entertainment needs and efficiency ambitious requirements of the user. This utility is demonstrated in the characteristics of the mobile value-added service selected by the consumers as outlined in Anckar and D'Incau (2002) study. Omnitele (2007) claimed that mobile operators can positively influence and direct market evolution in the early phase rather than stay passive and experience sooner or later the adverse effects of market maturity and increased competition. The lack of compelling content and the limited applications are the predominant factors inhibiting the uptake of m-commerce services (Consumer Affairs Victoria, 2004). Therefore, it is recommended that consumer interest is evaluated in order to foster the delivery of compelling content to the local mobile market. In addition, the results of the evaluation of the artifact suggest that there is potential for MSCQ to be adopted. The research model also demonstrated that demographic variables provide an integral role in explaining adoption.

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