Rapidly co-evolving technology adoption and diffusion models

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A B S T R A C T

Mobile and Internet-based technologies evolve rapidly and new hardware or software tends to stimulate related innovation. There are some indications that accessible and affordable technologies that allow the sharing of multimedia may attract interest from new groups of users, namely for marketing and by people who use mobile phones to take photographs but currently cannot share them easily and affordably. The question raised in this paper is whether the nature of these technologies has made the well-established theories and models of technology adoption obsolete. The constructs used come from the Diffusion of Innovation Model (DIM) and the extensions to it and the Unified Theory of Acceptance and Use of Technology (UTAUT) and 'the constructs of cost and perceived enjoyment are added. The data obtained from South African university students was analysed according to whether they classify themselves as innovator, early adopter, early majority or late majority adopters of Multimedia Message Services. Different factors were found to be significant for different diffusion groups but cost and perceived enjoyment (neither of which come from DIM or UTAUT) were significant for the majority. A second comparison was done for current users versus non-users and social influence was found to be significant for current users only; non-users identified perceived enjoyment (positively) and results demonstrability (negatively). The results were then compared with a similar study carried out in Taiwan by Hsu et al. (2007) and differences between the two studies highlight the importance of time, place and the respondents selected. The conclusion is that new technology adoption and diffusion models are needed for rapidly co-evolving mobile technologies.

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1. Introduction

1.1. Background

Continuous mobile technologies enhancement and the fact that mobile technologies meet or are ahead of most individuals' expectations rather than responding to demands has accelerated the individual's interests and usage of these technologies (Al-Debei and Al-Lozi, 2014). In addition, the hardware, applications, interfaces and social forces all interact to form what this paper will refer to as 'a rapidly, co-evolving technology'. The release of a new version of a leading make of mobile phone, or the sudden surge of popularity in a social networking application, or a new way of interacting with the technology may unexpectedly trigger a new wave of development, adoption and use in other segments of the mobile industry as well. New products from any one of the segments may stimulate demand for the others at any time. As will be discussed below,

this is exactly what happened in the co-evolving technology relating to the transmission and use of data bundles, multimedia and the almost universal fascination with social networking applications such as YouTube, WhatsApp, WeChat and Facebook. Mobile devices, 3G and 4G, Multimedia Message Service (MMS), and other forms of more-than-voice communication are further examples of rapidly, co-evolving technologies which enable applications such as mobile gaming, news services, online videos and location dependent services (Chong et al., 2012b; MacVaugh and Schiavone, 2010; Park and Ohm, 2014; Shim et al., 2014). Consumers also access multimedia via m-commerce applications, such as, cell-phone banking and virtual stores (Brown et al., 2003; Van Slyke et al., 2002). Being able to access video or movies has changed the world of mobile communication significantly, making it more multipurpose than before (Lin and Tong, 2013).

As a result there has been enormous, worldwide growth with regard to use of the Internet via mobile devices in the last decade (Lenhart et al., 2010). This has led to a corresponding increase in the number of data bundles being purchased by phone subscribers and hence the global mobile Internet market is anticipated to reach more than US$ 1423 billion by 2020 (Salgarkar, 2014).

Within the mobile telecommunications industry, the messaging service markets, which include short message services (SMS), MMS and mobile e-mail services are growing rapidly (Harno, 2010; Ogara and Koh, 2014; Wang and Lin, 2012). The mobile value-added services include a new wave of message services provided through the use of applications like WhatsApp and WeChat and these have become an important and growing source of revenue for telecommunication companies in part through the associated purchase of data bundles (Harno, 2010; Wang and Lin, 2012). In 2010, 65% of the consumers' mobile *Internet* usage was on text messaging services and 35% was on mobile data bundles (such as used by WhatsApp and Mxit) and entertainment services (Bere, 2013). This increased use of mobile Internet applications and demand for data bundles has encouraged the telecommunication industry to extend their growth.

In South Africa (SA), mobile phone data bundle usage is one of the largest in Africa (Kelly, 2014). In 2010 total mobile revenues in billion US$ for data were: South Africa: 1.9; Nigeria 0.5 and Egypt 0.8 (Page et al., 2011). However, Internet users statistics for 2014, presented as a percentage of population give a different point of view (Madagascar 74.7%; Mauritania 72.1%; Malawi 70.5%; Morocco 61.3%; Seycelles 54.8%; Egypt 53.2% and South Africa 51.5%) (Internet World Stats, 2015). The size in terms of population clearly affects the revenue. Various business activities are done via the Internet and there is expected to be an expansion in Internet use in future.

1.2. Multimedia Message Services

Photo-messaging was defined by Villi (2007:49) as "digital photos taken with a camera phone (mobile phone with built-in digital camera) and sent to another mobile phone". This definition is consistent with the first technology developed for the purpose of sharing digital photographs, namely MMS, but the definition has subsequently been widened by Hunt et al. (2014a,b) to "the exchange of messages using photographs". (It does, however, seem that this new definition is intended to refer to digital photographs and messages even if the origin and destination is not restricted to mobile phones.) This new definition was needed to accommodate the changes resulting from the end users' influence over the course of technology evolution; the intentions of hardware suppliers such as Nokia are often reformulated by the end users (Lillie, 2012). A good example of this is the way that the sharing of digital photographs from person to person, as allowed by MMS and email attachments, has been overshadowed by the next waves or evolutions of technology, particularly social networking and posting photographs on Facebook, videos on UTube and eventually the emergence of Twitter and WhatsApp. Hence MMS and subsequent ways of sharing photographs, video and audio (that is, multimedia) are examples of a rapidly co-evolving technologies. There are three ways of sharing multimedia items, namely using MMS, as an attachment to an email, and via an Internet-based application such as Facebook, Flickr, Instagram. (Hunt et al. (2014a) reports that 87% of respondents in his research use Facebook to share photographs.) These evolving technologies in turn influence social and cultural practices as explained by Lillie (2012), "The user-lead convergence of MMS with web-based applications of picture messaging has since developed into a number of diverse cultural practices" (Lillie, 2012: 82).

Despite these developments, text messaging via SMS remains extremely popular (see Fig. 1 for evidence of this in the Sub-Saharan context). Although MMS is presented as a follow-on from SMS (the gateway technology) which became feasible when cameras were added to mobile phones (the necessary hardware), it is not a replacement technology. MMS followed the SMS messaging model and hence was initially intended for sharing multimedia within a personal network (typically the recipients were a small group of friends and family) and from one mobile phone to another. However the delivery of MMS messages differs from SMS because MMS messages are first sent to the message centre, the recipient is then alerted to the availability of the message by means of an SMS, the receiving device must send information about its type (user agent header) and optionally, its capability (user agent profile) to the message centre which then transcodes the multimedia appropriately and finally the message is sent to the recipient phone (Samanta et al., 2009). This can only occur if the receiver phone supports MMS formats.

Within Sub-Saharan Africa sending text messages (80% of adults in the last 12 months) and taking pictures or video (53% of adult cell (mobile) phone owners) are the most popular activities using mobile phones (Pew Research Centre, 2015) and mobile phones are as common in South Africa and Nigeria as they are in the United States (Pew Research Centre, 2015). However compared with those who take photographs, relatively few Sub-Saharan Africans access social networking sites (19%) and hence it can be assumed that they do not share photographs via Facebook or other applications using Internet sites.