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Mobile Gaming: A Reference Model and Critical Success Factors

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ABSTRACT

The emergence of mobile commerce (mCommerce) has driven academic research to investigate mobile infrastructure requirements, mobile applications and services, and customer adoption. This work focuses on a specific mobile entertainment application – "mobile gaming". Considering both supply and demand issues, the study examines prior research on mobile gaming and proposes a model linking a set of critical success factors for the adoption of mobile gaming to a reference model for mCommerce

INTRODUCTION

Mobile commerce (mCommerce) development is currently driven by rapidly evolving technology. More recent developments include Internet-enabled handheld devices, which can take advantage of new mobile technologies such as General Packet Radio Service (GPRS) and Third Generation (3G). Consequently new value-added mobile services such as playing a game or watching news while on the move have also emerged.

Research results suggest that mCommerce services and applications generate significant revenues and enjoy relatively high adoption rates in countries such as Japan (Baldi & Thaung, 2002). However the adoption of mobile commerce is not yet universally widespread (Mallat, Rossi & Tuunainen, 2004); studying the dynamics of mCommerce services might provide useful insights for businesses which would like to develop an mCommerce-based revenue generating model (Siau, Lim, & Shen, 2001; Varshney & Vetter, 2002; Barnes, 2003). Both technical (supply) factors and factors arising from the demand side determine the success of an mCommerce business model and need to be studied.

Playing mobile games is an example of a mobile entertainment application. It is expected to become highly popular and profitable (Paavilainen, 2002; Paavilainen, 2004, p. 133; Kleijnen, de Ruyter, & Wetzels, 2003). To identify the set of factors critical to the success of mobile gaming, this study is based on the premise that customer adoption of mobile gaming services and products is linked to individual preferences and perceptions as well as to the provision and the environment (see for example Carlsson, Hyvonen, Repo, & Walden, 2005). The paper is organised as follows: first, definitions and background information are provided, and mobile gaming demand and supply are discussed. A theoretical model linking adoption factors and an mCommerce reference framework is proposed and discussed. The paper concludes with a brief summary.

DEFINITIONS AND BACKGROUND

Mobile commerce entails transactions with monetary value, including those conducted using the mobile Internet (Barnes & Huff, 2003). Similarly to electronic commerce mCommerce employs business-to-business (B2B), business-to-consumer (B2C) and consumer-to-consumer (C2C) contexts (Paavilainen, 2002). While electronic commerce (eCommerce) services are delivered using the publicly available Internet/WWW infrastructure, mCommerce utilises mobile communication networks providing content to subscribers only; typically a mobile phone is used. Mobile applications might be enhanced with location-related features, specific to the current geographic position of the customer (Anckar & D'Incau, 2002; Dholakia & Dholakia, 2002; Barnes & Huff, 2003; Varshney & Vetter, 2002).

Based on the results reported in (Kleijnen et al., 2003; Van de Kar, Maitland, de Montalvo, & Bouwman, 2003; Lee, Hu, & Yeh, 2003; Andersson et al., 2004) four generic categories of mCommerce services and related applications can been identified: "communication", information", "transactions" and "entertainment". Table 1 classifies these with regard to the three prevalent eCommerce contexts mentioned above. Existing offerings provide enough examples for the B2B and B2C models. In the C2C case it might be speculated that a peer-to-peer service similar to PayPal might soon become available (a mobile transaction application), and that the equivalent of the Web blog might emerge as a mobile information application.

Specific examples of mobile entertainment include downloading of music, video clips, photographs and ring tones, and playing mobile games ("mobile gaming"). A mobile game is defined as a "software game played on a mobile phone" (Wikipedia, 2006). Mobile games can be interactive, and might have location-based features (Maitland, van de Kar, de Montalvo, & Bouwman, 2005).

In all cases, the defining feature of mobile gaming is the ability of the player to engage in a game while changing his/her geographical location. The definition provided by Finn (2005) also emphasises that the player uses a mobile device and is "released" from the requirement to be stationary.

The best known case of mobile entertainment provider is the Japanese mobile phone company NTT DoCoMo. Entertainment is still the company's leading content and is responsible for over 50 percent of user activity (Baldi & Thaung, 2002). DoCoMo uses the Japanese mobile Internet through the iMode access platform. Mobile entertainment is driving the spread of iMode (Barnes, 2003; Funk, 2003) and mobile games constitute a significant portion of the available services in iMode.

Table 1. Mobile application contexts and categories

	Communication	Information	Transactions	Entertainment
B2B	Real time video calling	Inventory tracking; Dispatch and scheduling	Mobile POS.	
B2C	Mobile education Mobile Government (G2C)	Advertising; Product pricing; News; Forecasts; Location-based services	Banking; Finance services; Payment services Ticketing, Parking	Ring tones; Mobile games; Video; Adult entertainment; Gambling; Music
C2C	Short Message Service (SMS); Multimedia Message Service (MMS)	*Predicted: a blog-like service*	*Predicted: a peer-to-peer payment service*	Interactive mobile games

Figure 1. An mCommerce reference model applied to mobile gaming

	Layers	Players in the value chain
	Business	
7	**Business Model**	Companies/organization offering a service or an application :In-Fusio Pogo.com, Sega, Digital Bridges, Vodafone,
6	**Mobile Application Content**	Intermediaries: Sega, Digital Bridges
5	**Mobile Service** (e.g. SMS, WAP, MMS)	Intermediaries: Vodafone, NTT DoCoMo
	Interface	
4	**Application Platform** (e.g. Micro-browser, WAP)	Enablers and developers: Digital Bridges, Nokia, Yahoo!, Vodafone, Sonera's Zed portal
3	**Mobile Middleware** (e.g. J2ME, BREW, WAP, iMode)	Developers and vendors: Nokia, NTT DoCoMo
	Infrastructure	
2	**Mobile Devices** (e.g. Nokia N-Gage)	Vendors: Nokia, Motorola, Siemens, Sony Eriksson
1	**Mobile Network** (e.g.GPRS, 3G)	Enablers: Vodafone, NTT DoCoMo, Orange

Mobile applications can be investigated and evaluated from two perspectives: demand and supply. Analysing mobile entertainment supply (business models) in a European context Maitland et al. (2005) concluded that the consumer demand was uncertain and as a consequence, the business models were not stable – in contrast with the results reported earlier by Anckar and D'Incau (2002) who found that interactive mobile gaming was one of the top applications consumers were likely to adopt. Confirming perhaps this prediction and despite the uncertainty mentioned the mobile gaming market continues to demonstrate growth (MobileMag, 2004).

MOBILE GAMING SUPPLY: A REFERENCE MODEL

A number of general reference frameworks for the study of mCommerce have been suggested (Barnes, 2003; Varshney & Vetter, 2002). In this paper the seven layer reference model proposed in (Petrova, 2005) is applied (Figure 1). For each layer, the key players are identified and examples are provided.

Infrastructure Layers

Layer 1 (Mobile network) provides access and ensure quality of service through advanced technologies such as 3G and GPRS, needed to building permanent connections in the case of real-time interactive games (Mobile Games, 2001; Paavilainen, 2002; 2004, p. 65). In this layer, network operators occupy the key positions. However mobile device vendors are equally important given the need for devices with extended functionality (3G, Java) and a configuration including a colour screen, large memory, and a fast processor (Leavitt, 2003). As enablers, network technologies and mobile devices capable of supporting interactive and 3D games will play a critical role in the adoption of mobile gaming (Sarker & Wells, 2003; Finn, 2005).

Interface Layers

WAP (Wireless Application and iMode are two types of middleware commonly used (Baldi & Thaung, 2002; Lee et al., 2003; Finn, 2005). The interface layers lack standardisation, thus presenting a problem for game designers. Currently used platforms such as J2ME (Java 2 Platform Micro Edition) and BREW (Binary Runtime Environment for Wireless) offer to resolve some of the incompatibility issues.

Other major players in the interface layers are portal developers, network operators, content providers (game developers), mobile service providers and traditional Internet portal suppliers (Buellingen & Woerter, 2004; Paavilainen, 2004, p.68). Examples include Nokia (a device vendor company which develops a cell-phone micro-browser), and Sonora's Zed Internet portal (it provides information about mobile gaming).

Business Layers

Key players include conventional game developers such as Sega (who originally were a large video game provider), and new entrants attracted by the market potential. Mobile gaming is often offered through content aggregators and WAP portals such as Digital Bridges (Mobile Games, 2001). Different payment mechanisms are implemented, including a dedicated payment gateway (In-Fusio), or subscription-based payment (SMS games).

Companies tend to cooperate: for example, In-Fusio are aligned with network providers (Orange, France Telecom and T-mobile) to develop embedded games, and with the intermediary company Vizzavi Portal to provide WAP games (Mobile Games, 2001). Another trend is the integration of mobile gaming with a location-based application. The multiple-player interactive outdoor adventure game that blends virtual community and real world is an example of such an advanced application (Baldi & Thaung, 2002). As mentioned, developers encounter challenges when trying to ensure game compatibility: in addition to the need to accommodate different languages, there are currently more than 200 device platforms and more than 80 mobile operators provide services, in numerous languages (Bhatia, 2005).

A number of players perform across different functional layers. There are also differences between European and Japanese, or European and American markets where the key players may develop suitable business strategies for specific contexts while operating in different legislative environments (Maintland et. al, 2005; Kymaalainen, 2004, p. 91; Henten, Olesen, Saugstrrup, & Tan, 2004).

MOBILE GAMING DEMAND: CRITICAL SUCCESS FACTORS

Some of the research in mCommerce adoption and specifically in mobile entertainment adoption has been based on constructs extracted from existing adoption models (for example, Barnes & Huff, 2003; Pedersen, 2005; Carlsson et al., 2005; Pagani & Schipani, 2003). Social factors and other micro-level determinants have been added to the models developed in (Barnes & Huff, 2003; Pedersen, 2005). Pedersen, Methlie and Thorbjornsen (2002) consider the three different roles a mobile user plays as a "consumer", a "network member", and a "technology user", and propose an adoption framework based on user preferences from the perspectives of these roles. Baldi and Thaung (2002), and Moore and Rutter (2004) also generate some key influencing. Table 2 presents a summary of these results. It identifies a set of mCommerce adoption factors which might be potential drivers of mobile gaming adoption.

Kleijnen et al. (2003) study mobile gaming adoption, including four of the constructs of the diffusion of innovations theory: complexity, compatibility, relative advantage, and communicability. Based on previous results they identify four additional constructs (perceived risk, critical mass, navigation and payment options). In subsequent work they found that for users defined as "game players" the three most important adoption factors were navigation and communicability, followed by perceived risk &, payment options (Kleijnen et al., 2004)

Based on the literature review it was possible to identify ten critical success factors for mobile gaming adoption. The five constructs of the diffusion of innovations model (complexity including navigation, compatibility, relative advantage, communicability/observability and trialability) were used and five additional constructs (facilitating conditions, self-efficacy, trust, image and normative beliefs) were added. The relationships between the potential adoption drivers (Table 2) and the set of critical success factors is shown in Table 3.

To create a model linking mobile gaming demand and supply, in Table 3 the adoption factors are mapped onto the mCommerce reference model (Figure 1). Only the business and the infrastructure layers are used as the work reviewed does not provide enough grounds to differentiate significantly between "interface" and "infrastructure" or between "business" and "interface".

The work of Shchiglik, Barnes, Scornavacca, and Tate (2004) presents empirical results from a study where users were involved in real-life

Table 2. Potential drivers of mobile gaming adoption. Sources: a) Barnes & Huff, 2003; b) Pedersen, 2005; c) Carlsson et al., 2005; d) Pagani & Schipani, 2003; e) Pedersen, et al., 2002; f) Baldi & Thaung, 2002; g) Moore & Rutter, 2004.

		a	b	c	d	e	f	g
1	Accessibility, Mobility,	✔		✔			✔	✔
2	Saving time		✔	✔			✔	
3	Fun / A "killing time" application			✔	✔		✔	✔
4	Usefulness	✔	✔	✔	✔	✔	✔	✔
5	Simplicity of use	✔	✔	✔	✔	✔	✔	✔
6	Personalization				✔	✔	✔	
7	Owners' identity	✔		✔		✔	✔	✔
8	Social status	✔	✔	✔	✔	✔	✔	✔
9	Interactive innovation	✔					✔	
10	Culture	✔					✔	
11	Subjective norms	✔	✔		✔	✔		
12	Age	✔			✔		✔	✔
13	Attitude to new technology	✔	✔	✔	✔	✔		
14	Cost	✔	✔	✔	✔		✔	✔
15	Privacy risk				✔			✔
16	Security risk	✔	✔		✔			✔
17	Economic environment	✔	✔				✔	
18	Technical environment	✔	✔			✔	✔	

Table 3. Critical success factors for mobile gaming

Ref. model	Factor	Proposition
Business	**Compatibility** (drivers 3, 4)	Playing a mobile game as an activity might meet the needs of a specific consumer group (Kleijnen et al., 2003). Examples include commuters with time to spare (Leavitt, 2003), the Japanese market, (Barnes & Huff, 2003), "addicted "players (BBC, 2005).
	Facilitating conditions (drivers 17, 18)	Payment options impact adoption (Kleijnen et al., 2003; Roman, 2005). Billing conditions and support options might impact on users' willingness to adopt (Moore & Rutter, 2004; Barnes & Huff, 2003; Pedersen, 2005).
	Trialability (driver 14)	Mobile gaming has a level of "addictiveness" (BBC, 2005). Free trials might lead to "addiction" and subsequent adoption (Moore & Rutter, 2004; Barnes & Huff, 2003).
Infra-structure interface	**Self-Efficacy** (drivers 12, 14)	Due to device limitations, a large group of potential "aged' gamers might not be able to play (Moor & Rutter, 2004). Technical serviced need to match the requirements needs of different customer segments (Pedersen, 2005).
	Complexity (drivers 1, 5, 6, 18)	The ease of use of an entertainment application is of utmost importance as it is expected to be an enjoyable experience (Moore & Rutter, 2004). In mobile game playing clear navigation influences response time and might have implications for the decision to play (Kleijnen et al., 2003; Barnes & Huff, 2003).
	Trust (drivers 15, 16)	Perceived fear of privacy invasion and/or lack of security might influence consumer choice (Kleijnen et al., 2003; Barnes & Huff, 2003).
	Relative advantage (drivers 1, 2, 9)	The ubiquity and accessibility of mobile entertainment may satisfy the demand for a "killing time" and relaxing "fun" service (Anckar & D'Incau, 2002; Kleijnen et al., 2003; Dholakia & Dholakia, 2004; Carlsson et al., 2005; Barnes & Huff, 2003). A technology based advantage is the offer of interactive/multi-player games.
	Observability/ communicability (drivers 8, 10)	Refers to the ability to communicate within a peer group; to be observed playing which might be of social importance (Kleijnen et al., 2003; Funk, 2003; Barnes & Huff, 2003).
	Image (drivers 6, 7)	The personalized use of a mobile phone might lend its owner status-related features (Baldi & Thaung, 2003; Funk, 2003; Barnes & Huff, 2003).
	Normative beliefs (drivers 10,11, 13)	Playing the same game as one's friends might facilitate social acceptance; social pressures influence customer perceptions and decision making (Barnes & Huff, 2003; Pedersen, 2005) and facilitate building a critical mass (Kleijner et al., 2005).

mobile gaming (playing a WAP-based mobile game). It can be used to validate the proposed model. In the study, ten categories of gamers' observations were identified. Six of the critical success factors (Table 3) are manifested in the observation categories: Complexity, image, facilitating condition, trust, relative advantage and compatibility. The absence of observations related to the rest of the critical success factors might be explained with the experimental nature of the study and the selection of the participants – for example, they all were high Internet users.

DISCUSSION

The factors groupings in Table 3 emphasise the role played by the service provision model and indicate that all players in the supply chain will need to contribute to the value proposition – as exemplified currently by iMode services in Europe (Maitland et al., 2005) and in Japan (Natsuno, 2003, p. 88).

They also reflect the fact that currently mCommerce is mostly technology driven and the business models are relatively immature. Empirical findings also show that that adoption of mobile gaming is very strongly related to the infrastructure: Kleijnen et al. (2004) found that the most important predictor was navigation, and Shchiglik et al. (2005) importantly observed that there was a need for more game functionality. Yoon, Ha &, Choi similarly found that ease of use was important for players over the age of 20.

The interface layers are not explicitly linked to any critical factors. However their role as enablers will be important to adoption especially in the area of developing common standards and compatible platforms (Maitland et al., 2005) and providing additional functionality such as storing personal scoring details (Shchiglik et al., 2004).

A limitation of the proposed model is that it does not take into account country-specific factors such as the legislative environment. It needs to be extended to include the effect of policy and regulatory factors and their role in establishing a competitive environment, for example the cost of frequency bands (Henten et al., 2004). Another environmental factor to consider is the ethnic and social diversity of different countries and cultural processes such as enculturation and acculturation (Daghfous, Petrof, & Pons, 1999).

The main advantage of the model is that it allows to link research variables representing mobile gaming 'demand' to an mCommerce reference model layers representing 'supply. This might make it possible to interpret research results with reference to the relevant mCommerce industry players and to provide practical recommendations, especially for the development of innovative business models. An empirical study is currently in progress investigating mobile gaming services provision. The objectives are to gauge the degree of penetration of mobile gaming, to identify the major consumer groups, to determine referred mobile game types and to identify the most an important factors predicting adoption. Based on (Venkatesh et al., 2003; Burton-Jones & Hubona, 2005) the project will be extended to include a socio-cultural perspective. Results obtained might have practical implications with regard to determining the parameters of the consumer segment likely to adopt mobile gaming as an entertainment activity in New Zealand context

CONCLUSION

The paper explores mobile gaming from both supply and demand sides. An existing reference model for mCommerce is used to identify key players associated with the main mobile industry segments. On the demand side, adoption drivers related to percept ions and technology are identified and summarised. The resulting key success factors can be used to inform a research model to study adoption, using them as variables and formulating hypotheses based on the propositions underpinning each factor. Matching the critical success factors to the reference model for mobile gaming will allow using research results for drawing conclusions, relevant to the development and provision of mobile gaming services and applications.

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