Mobile Services and Applications: Towards a Balanced Adoption Model

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Abstract— **This paper synthesizes prior research to develop a novel model for the study of the adoption of mobile business services and applications incorporating a demand and supply perspective. The model complements and extends existing models while also leveraging data from industry reports; in particular, it focuses on the interrelationships between participants in the mobile services value chain and the impact of these interrelationships on the adoption of new services in a competitive and technology-saturated service market. There has been to date limited research reported that has considered the dynamics of the interrelationships between customers and (layers of) multiple service providers as a factor in the adoption and acceptance process; the proposed model addresses this gap and advocates the use of a combination of design science and service science methodologies. It is concluded that not mobility *per se* but the way mobility is used to create value plays a significant role as an adoption driver, and that the quality of the service and its relevance to personal or business lifestyle are the most important decision making factors. It is also asserted that while innovative mobile services (i.e., services that are not already offered using a different technology) may be compelling if they meet lifestyle needs, mobile services replacing or complementing existing ones will be favored by customers only if their quality is exceptional and motivates 'switching' to the mobile service.**

Keywords-mobile services; adoption; mobile commerce; quality of service expectations; lifestyle requirements; mCommerce.

I. INTRODUCTION

Business transactions between participants (e.g., customers, businesses) enabled by mobile data networks are commonly referred to as mobile commerce (mCommerce) via a range of related mobile services and applications [1-2]. A specific characteristic of mCommerce is its potential to support customer mobility by offering services that dynamically adjust to be available at the location in which the mobile customer operates [3]. In addition, mCommerce transactions may be facilitated by a specific form of payment known as mobile payment (mPayment) [4]. The definition of mCommerce adopted in this study is derived from [5]: 'A value-added service that enables mobile customers to conduct reliable and secure transactions through specifically-designed mobile applications'. Further, mobile business (mBusiness) services expand mCommerce to include not only transactions between participants but activities such as servicing customers, and collaborating and conducting mobile transactions with business partners based on an appropriate business model (adapted from [6], p. 685). Finally, with respect to the type of interaction between participants, most mCommerce transactions can be classified applying the categories used to classify electronic commerce (eCommerce) transactions; however at present B2C (business-to-customer) mobile transactions prevail [1].

A number of general frameworks and models for the study of mobile services and their adoption have been proposed in prior work drawing on eCommerce adoption studies and often including variables such as usefulness, ease of use, and usability [7-11]. Additional specific constructs such as customer mobility [2]; location awareness [12-13], trust [14], service cost [15], and perceived value proposition [16-17] have also been considered. A range of country-specific adoption barriers have been identified from customer, technology, company and business perspectives [18-20]. A global view of the effect of the legislative environment (government intervention) on location-aware services has also been provided in [21].

While empirical studies have been able to identify some of the factors affecting customer decisions, the dynamics of the processes of meeting customer needs and preferences (i.e., mobile business service demand) by the gamut of industry players (i.e., mobile business service supply) has not been studied in depth. With customers becoming both better informed and more experienced as technology users, it can be expected that additional factors may emerge from a study of the adoption processes from multiple perspectives and in a contemporary context including customer perceptions about mobile business service value [22-23].

It has previously been suggested that in order to explain mCommerce adoption processes both the supply and the demand side may need to be included in a comprehensive adoption framework [23], and that the relationship between customer and service supplier is one of the four main aspects of a mobile service [24]. The objective of the study presented here is to derive and extend an explanatory model capturing the relationships between supply and demand factors that can be used further to investigate how customer lifestyle requirements and expectations about the quality of a mobile business service affect market demand for these services and contribute to actual mobile service use.

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The rest of the paper is organized as follows: The next section reviews the relevant literature and provides background information. The section following describes the proposed model including its variables and the relationships between them. The last section discusses the model from the perspective of further research and provides a conclusion.

II. MOBILE BUSINESS SERVICES AND APPLICATIONS

General mobile business-to-customer services (mobile business services) and enabling mobile services (e.g., mPayment) are delivered to customers as a result of the business interactions within the mobile business value chain [16][25]. Stakeholder interactions occur across multiple networks: the public Internet, the wireless networks provided by mobile operators, and the private networks, which may be operated by intermediaries such as enabling service providers. The adoption of a mobile business service therefore may be dependent on factors related to the role and contribution of each stakeholder group, on the relationships across the value chains in which the stakeholders participate, and on the regulatory and socio-economic environment within a single country or region, or across regions.

The relevant mobile business service supply stakeholder groups can be classified as: 1. Mobile network operators (MNOs); 2. Mobile device developers/vendors (MDDVs); 3. Mobile network services providers (MNSPs); 4. Mobile application developers (MADs); 5. Mobile service content developers (MSCDs); 6. Mobile business services providers (MBSPs); 7. Enabling mobile service providers (EMSPs); 8. Mobile business service aggregators (MBSAs); and 9. Legislators/regulators (LRs) [26]. All stakeholders contribute to the creation of customer service value and may affect customer demand. Service provision and value may also be affected by relevant regulatory and legislative context (Fig. 1).

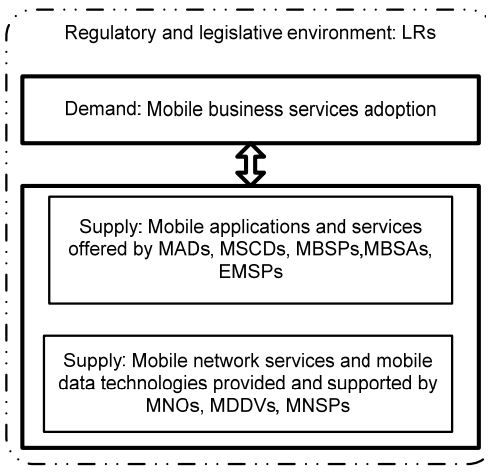

Figure 1. Mobile business service supply and demand framework (adapted from [27]).

At present SMS (Short Messaging Service) and MI (mobile Internet) are the mobile data technologies providing mCommerce platforms. A service may require an application developed for mobile devices e.g., downloadable mobile game software. Finally, services may be developed for multiple platforms: SMS banking provides some of the functionality of a banking online site designed for MI access, however different authentication mechanisms may be used.

While some mobile business services may extend or enhance existing services (e.g., SMS banking) others may also incorporate innovative features such as mPayment and personalization based on location awareness (location-based services – LBS). mPayment and LBS can be viewed both as independent business services, and as enablers of other mobile business services [26]. As the providers of these enabling services participate in the mCommerce value chain, factors related to location and payment can be expected to play a role in user adoption [26][28-32].

A number of classifications of mobile services and applications have been proposed in the literature including a seven-dimensional taxonomy [1]. The results indicate first that most contemporary mobile business services use a B2C model and involve significant personalization as the customer is normally 'known' to the service. Second, approximately half of the services include transaction options and similarly half of them are location-based. While at present the number of synchronous and asynchronous services is approximately the same, the trend in the temporal dimension is to develop synchronous services able to switch to an asynchronous mode when the network is overloaded.

SMS mobile learning (SMS learning), mobile banking (mBanking) and mobile gaming (mGaming) are three typical examples of interactive, transactional B2C mobile business services, which allow (or require) personalization, may run in real time or asynchronously, and may be location-based. All three have been studied empirically in both global and national contexts with respect to their adoption, acceptance and usage. Results indicate that customer requirements and expectations about the functionality of the service, about its design, and about the support of enabling services may play a critical role in the adoption and use of mobile business services.

It is envisaged, for example, that the mass adoption of mBanking would depend on the provision of secure, reliable and easy-to-customize user interfaces that can be implemented on a multi-standard, multi-functional mobile device designed for a long life and a 'rugged' service; customer requirements and the specific socio-cultural context may play a significant and critical role [33-38].

With respect to SMS mLearning, results indicate that it may be difficult to use due to the screen size and text message limitations for SMS learning, may be too costly to be afforded by a student on a limited budget, and may also be perceived as intrusive if large message traffic is generated by the service. It can be argued therefore that to overcome these adoption barriers, a successful mLearning service needs to be affordable, and to provide additional value by being accessible while the learner is travelling (i.e., compatible with the learner's daily

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routine), flexible and allowing customization, and available on demand [39-41].

In the case of mGaming, findings from the literature highlight the critical role of both customer perceptions/attitudes and supply chain factors as determinants of adoption and use [42-44]. Customer perceptions about the value of playing a mobile game in the context of their lifestyle may be significant motivators, for example, 'expressiveness' [45] and 'socialization' [46]. On the other hand, enabling services such as payment, and game and device design, may play an important role as contributors to the quality of the mobile gaming experience [47-49].

We draw on these collective findings to suggest that first it is not customer mobility *per se*, but the way service support for customer mobility is used to create customer value, that plays a role as an adoption driver. Second, the quality of the service and its relevance to personal or business lifestyle are the most important decision making factors in the adoption process. There is also evidence to indicate that while innovative mobile services (i.e., services that are not already offered using a different technology) may be compelling if they meet lifestyle needs, mobile services replacing or complementing existing ones will be favored by customers only if their quality is exceptional and motivates 'switching' to the mobile service; here, appropriately designed enabling mobile services may have a significant motivational impact.

The above analysis has enabled us to derive a comprehensive model representing the factors that influence the adoption of mobile services. In particular, we have determined the critical customer benefit-related success factors for the adoption of a mobile business service, and the role of enabling services in the adoption process. The explanatory model that sets out these factors and their inter-relationships is presented in the next section.

III. AN EXPLANATORY ADOPTION MODEL

The Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB) and the diffusion of innovation theory are among the models used to inform the research design of empirical studies investigating the factors influencing intention to use a mobile business service, and actual use. However these models have some limitations; for example it was recently reported that while the two TAM variables *perceived usefulness* (PU) *and perceived ease of use* (PEU) may be predictors of the *intention* to use a technology, these variables have not been found to be good predictors of *actual usage* [50]; however *intention to use* was found to be a good predictor of *actual usage* [50] and *continuous usage* [11].

It has been suggested in prior work to include in adoption models variables measuring the benefits of the technology to the customer, as adoption models measuring technology do not measure the customer value of the technology [51], and to investigate perceived service value as an adoption factor [11]; [23]. Building on prior work and from the perspective of how a service may provide value and benefit the customer, the factors influencing the adoption of mobile business services can be grouped as shown below [26-27][38][41][52].

- Customer quality of service expectations: Technology factors that relate primarily to the infrastructure and the service architecture (e.g., interoperability of devices and protocols, bandwidth availability, device features and functions, connectivity). The customer may benefit from the advancement of technology, which makes it possible to deliver a mobile business service.
- Customer lifestyle requirements: Consumer factors that relate to how useful and value–adding a mobile business service is perceived to be. For example, in an investigation of how mobile services could help the elderly it was found both PEU and an actual need of the service were important as acceptance criteria [53]. Other factors may include content personalization and localization, service ubiquity, timeliness, convenience, cost, privacy, trust.

Customer quality of service expectations and customer lifestyle requirements are included in the synthesized model as mobile business service adoption antecedents. The model (Fig. 2) is described in more detail next.

A. *Variables and Relationships*

Variable 1 (customer quality of service expectations) refers to the customer in the capacity of a mobile technology user, to follow the terminology in [23]. The variable represents customer expectations about service quality. Possible measures include mobile data service interface PEU (and perceived ease of learning how to use it), and expectations about mobile network performance parameters such as network delay (e.g., synchronicity, a service working in real-time), 24/7 access to the network, seamless handover when the customer is mobile, service availability across different subscriber mobile networks, and affordability (data service cost).

Variable 2 (customer lifestyle requirements) refers to the customer as a consumer of the mobile business service [23]. The variable represents customer requirements with respect to the value of the service and the benefits it may bring. Possible measures include PU and PEU of the mobile business service, perceived service functionality, perceived compatibility with the customer's daily routine, perceived benefits of access to the service 'on the go' compared to other similar services, awareness of the service, perceived added value through customer mobility support, perceived service 'persistence' (sustainability), and affordability (service cost).

Variables 3 and 4 represent constructs used extensively in adoption studies, for example, empirical investigations based on TAM, or on TPB. Variable 3 (intention to use) signifies customer attitude towards using a mobile business service in the future. Variable 4 (actual use) can be measured both through customer self-evaluation (subjective, or perception-based), and through data obtained from service providers (objective, or fact-based) [11][50].

Variable 5 (perceived customer demand) is a new variable, reflecting [multiple] service provider perceptions about customer behavior with respect to the adoption of a mobile business service.

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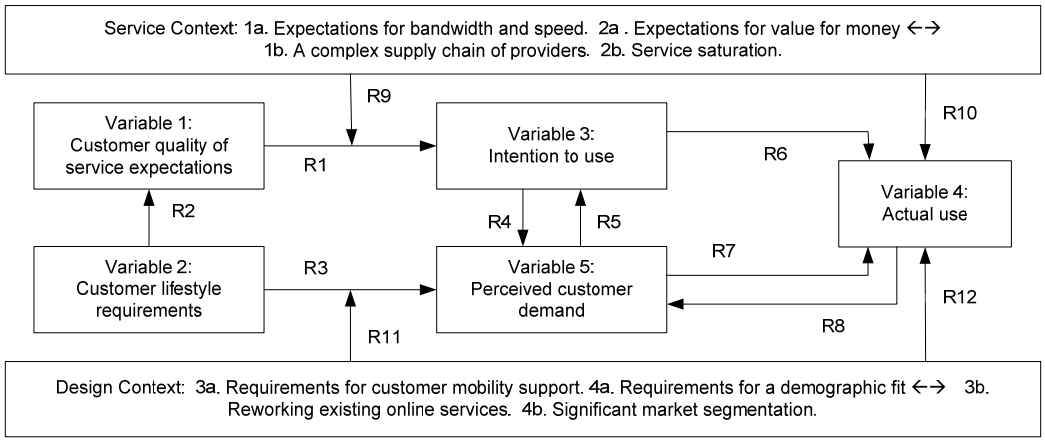

Figure 2. An explanatory model for mobile busines service adoption

Some findings suggest that there may be differences between the intended value proposition and customer acceptance of the proposition [17] due in part to the difficulties involved in communicating it [54]. Possible variable measures include service provider intentions to invest in developing and maintaining a service based on projections about market demand.

Multiple relationships exist between and among the variables. The model depicts a set of twelve relationships that explain the adoption process on both the demand and the supply sides of the value chain, based on the concept of creating value [11][23][25].

Relationships R1-R8 are internal; they capture the interrelationships among the five model variables and relate to the demand side of the value chain - customer perceptions, attitudes and behaviors (Table 1), or perceptions regarding these demand factors. The external relationships R9-R12 refer to the perceptions, attitudes and beliefs of the industry stakeholders. They link the context variables to the rest of the model and make explicit the role of the application design of the mobile business service and the design of the related mobile application(s) as factors influencing adoption and affecting actual use.

The mobile business service supply chain players identified earlier (Fig. 1) can be viewed as the co-creators of mobile business service value [55] and are represented in the explanatory model (Fig. 2) through the two context variables: 'service context' representing the business view of the service and 'design context' representing the technology and services supporting or leveraging customer mobility.

The viability of the business model depends on the perceived service value. For example, SMS based 'test revision' scenarios designed to be used by commuting learners offer a study aid available wherever the learner goes. The convenience of such a learning service may contribute to forming a positive perception as it fits in with the lifestyle of a learner frequently changing locations and spending time in traffic. However additional service value may be added by appropriate service design meeting the learner's quality of service expectations: for example, options such as micro-payment (for just one question/answer pair), a discount for a bundle of questions/answers, and supporting service availability across different subscriber networks, may all provide motivation for actual use [41].

B. The Design Context and the Service Context

The role of the design context may be especially significant where an application needs to be developed in order to deliver or support a service. For example, the perceived value of customer mobility support may also depend on the application design: an application, which requires high mental concentration while being used may be unlikely to be convenient to customers on the move [53].

The service context focuses on service design and on the business model used to deliver new and flexible mobile services [56]. The two contexts complement each other. An example of a partnership model for application design and development aligned with service design and provision, which includes all stakeholders, involved in creating value and bringing benefit to the customer, is provided by the SmartTouch project. SmartTouch is a service based on NFC (near field communication) technology and includes an mPayment and mobile ticketing application. The project development and the commercialization phase are supported by the partners in the international SmartTouch consortium, which includes developers, hardware manufacturers, and data service and business service providers [57].

IV. DISCUSSION AND CONCLUDING REMARKS

The synthesized model presented here in Figure 2 provides a framework for the investigation of the process of adoption of mobile business services, including a multiple stakeholder perspective, which provides a balanced view of both the supply and demand side of mobile business service provision.

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TABLE I. MODEL RELATIONSHIPS

Relation-ship	Type	Descriptive Definition
R1	Internal	*Customer expectations* regarding the *quality* of the mobile data and mobile business service as a motivator and *intention to use* decision making factor.
R2	Internal	*Customer requirements* about the particular mobile services and the *value added* to a service by user mobility support as a factor in determining the *service quality requirements* and indirectly as a factor in decision making about *use*.
R3	Internal	*Customer requirements* about particular mobile services and the *value added* to a service by user mobility support as a driver of service *demand*.
R4, R5	Internal	*Intention to use* as a predictor of projected *demand*; service awareness emerging as a result of higher *perceived demand* as motivator for *intention to use*.
R6	Internal	*Intention to use* as a predictor of the *actual use* of a mobile service.
R7, R8	Internal	*Perceived demand* for mobile services as a predictor of *actual use*; *actual use* as a predictor of *perceived demand*.
R9, R10	External	*Mobile service design* as a mediator of mobile business service *quality expectations*; *mobile service design* as a determinant of *actual use*.
R11, R12	External	*Mobile artifact design* as a mediator of mobile service *lifestyle requirements*; *mobile artifact design* as a determinant of *actual use*.

The model may be used to investigate how the service adds value through mobility support (possibly competing with other similar services, which do not support user mobility) and the perceived benefits of the service.

While empirical results obtained in adoption studies have been used to define the constructs of the model, two other theories have been utilized to contextualize it: design science provides a perspective on the relationship between customer requirements and expectations and the design of the mobile application, while service science provides a perspective on how the respective mobile service may generate demand and become viable.

The model is based on the assumption that understanding the motivators of customer decision making about using a mobile business service may provide useful feedback both to developers of mobile applications and to mobile business service providers. Thus it should contribute to the development of viable and valuable mobile service scenarios in an environment characterized by the emergence of new services and technologies, with a significantly increased spectrum of customer choices and business investment opportunities.

In the next stage of this research we will gather and analyze qualitative data in order to operationalize the variable *perceived customer demand* and the two context variables. It is proposed to investigate the role of the service context as a mediator in the relationship between customer quality of service expectations and intention to use/actual use, applying a service science perspective [58] assuming that: i) the value provided through a mobile service, which is able to support customer mobility ('mobility value') has a dual customer/provider nature and needs to be investigated from both customer and service provider perspectives [59], and ii) mobile services are innovative and therefore it is important for their uptake to identify the critical features, which may positively influence use and demand [60].

It is proposed to study the mediating role of the design of the application underlying the service in the relationships between customer lifestyle requirements and perceived customer demand and between perceived customer demand and actual use from a design science perspective. The design science cycle starts with identifying the problem, and continues through the suggestion, development and evaluation steps to the conclusion step, with feedback loops at every step [61]. The study approach is based on the assumption that in the design of mobile applications the problem space is 'fuzzy' (i.e., the problem to be solved is not well defined) and therefore the application evaluation and conclusion steps cannot be completed without understanding how the new mobile artifact or mobile application may fit in a number of possible service use scenarios [23][62].

Methodologically, the research can be viewed as a sequence of two distinct but related investigative phases. The first phase is concerned with the investigation of selected mobile services and the adoption process associated with these. The predominant research thinking underpinning this phase of the work is objectivist although research methods more aligned to an interpretivist approach are deployed. For example the hypotheses formulated and tested statistically in the quantitative studies on mobile banking and mobile gaming adoption highlighted the role of perceived usefulness and of compatibility with customer lifestyle requirements and expectations as adoption antecedents [38][45]. The exploratory analysis of the quantitative survey data gathered for the study of mPayment adoption indicated that the more customers were aware of the service the more likely they were to become regular users and create demand for it, and also leading to improving the design of the service (e.g., user interface), and the design application supporting it used (e.g., security concerns) [63]. The qualitative study of mLearning adoption identified support for mobile lifestyle and providing rich but relevant information as the key contributors to the perceived service value and therefore likely demand drivers [41]. Finally, the research review of LBS mapping LBS development stages to customer expectations and requirements showed that while customer expectations about the quality of the service were high customers were are likely

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to adopt even a 'low tech' service if their requirements were met [64].

While empirical results from prior work have informed the development of the model proposed earlier an interpretivist approach will be adopted for the second phase of the investigation where rich subjective qualitative data will be gathered and analyzed with respect to the new model variables [65, pp. 121-134; p. 172][66, pp. 87-116]. Thus with respect to the overall methodology the study can be classified as exploratory in design [67] and following a mixed methods approach [68, p. 642]. It is believed that using a research strategy combining qualitative and quantitative research methods will facilitate a better understanding and interpretation of the relationships between the model variables [68, p. 653].

The contribution of this work to the body of knowledge is a comprehensive explanatory theory of mobile services and applications adoption; in addition, the model may be used to complement the design science evaluation of a mobile application by developing and validating frameworks for evaluating the service value potential of the application from a service perspective [69].

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