The Influence of IT Features on M-commerce User Behaviors

Philippe Marchildon and Pierre Hadaya
Department of Management and Technology
ESG-UQÀM
Montréal, Canada
e-mail: marchildon.philippe@courrier.uqam.ca
hadaya.pierre@uqam.ca

Abstract— **M-commerce research suffers from critical shortcomings due to an extensive reliance on TAM. As such, little is known about mobile IT artifacts, their features and their influence on m-commerce user behaviors. Based on evidence which suggests that the use of IT artifact features vary over time and that it is the specific features used at any point in time that determine work outcomes, it is important that we better understand the influence of mobile IT artifact features over time. To do so, we propose to use a different theoretical lens than TAM, to study sensory mobile IT artifact features and to distinguish between stages of the m-commerce adoption process. Accordingly, the literatures on IT artifacts, Kaplan and Kaplan's (1982) framework and mobile IT artifact features are examined to propose a research model, its related hypotheses, and methodological aspects regarding its empirical validation. Finally, the proposed model's anticipated contributions are discussed.**

Keywords-component; M-commerce; IT features; Kaplan and Kaplan's preference framework; longitudinal

I. INTRODUCTION

M-commerce, defined as "the use of mobile information technologies, including the wireless Internet, for communication and coordination within an organization, between an organization and other organizations and/or customers, and for management of the firm" [1, p. 3], is an emerging trend in today's business reality [2]. As with many other IS research topics, the Technology Acceptance Model (TAM) has been extensively used by m-commerce researchers to support their theoretical reasoning. This overwork of TAM has brought unexpected side effects that now undermine further knowledge development [3]. More precisely, to this day, most m-commerce researches have failed to study the different stages, as well as the tangible antecedents of individual behaviors throughout the m-commerce adoption process. Thus, despite the increasing importance of this new way of doing business, little is presently known about mobile IT artifacts (e.g. Internet-enabled PDAs and smart phones), their features and their influence on m-commerce adoption individual behaviors throughout the m-commerce adoption process [4]. As such, despite evidence which suggests that the use of IT artifact features may not only increase but also decrease over time [5], and that it is the specific features in use at any point in time that influence and determine work outcomes achieved trough IT artifacts [6, 7], no sound explanation has yet been provided for variations in the use of mobile IT artifact features. Since the success of m-commerce hinges on mobile IT artifact features, the users' willingness to adopt them, and to engage in activities requiring their usage, a better understanding of their design characteristics and their influence on user behaviors over time is needed [8].

The objective of this study is thus to investigate the influence of mobile IT artifact features on m-commerce users over time. More specifically, the present research aims at answering the following research question: Why does the usage of mobile IT artifact features vary over time? In particular, this study will investigate whether differences exist between features that influence the behavior of m-commerce adopters and those that influence the behavior of post adopters. To do so, a longitudinal stance is proposed which departs from previous m-commerce research by leaving aside the TAM framework and by focusing on a new theoretical lens: Kaplan and Kaplan's preference framework.

The paper proceeds by first examining the literature on IT artifact conceptualizations, Kaplan and Kaplan's [9] preference framework and mobile IT artifact features. Based on these theoretical underpinnings, a research model and its related hypotheses are then developed. This is followed by a discussion that addresses several key research methodological aspects. The paper concludes by presenting the anticipated theoretical and practical contributions of the research.

II. THEORETICAL DEVELOPMENT

A. Conceptualization of the IT Artifact

Early attempts to differentiate artifacts from one another led to the identification of two different sets of distinguishing characteristics: primary and secondary attributes [10]. Primary attributes are those which are "essential to the object or substance and so are inherent in it whether they are perceived or not" whereas, "secondary attributes are those which are perceived by the senses, and so may be differently estimated by different percipients" [11, p. 702]. Subsequently, Griffith and Northcrafth [7] proposed a similar categorization by differentiating between objective and psychological features. As noted by

 ISBN: 978-1-61208-329-2

Downs and Mohr [11] and later on by Griffith and Northcraft [7], because secondary characteristics are better understood as descriptions of users, not of artifacts, and because primary features are highly idiosyncratic, studying artifacts by using either sets of attributes alone leads to critical shortcomings. As such, these authors have suggested that scholars should develop interactive models that combine both primary/objective and secondary/psychological sets of attributes to assess the defining features of IT artifacts and their impacts.

Recognizing the potential of interactive models and anchoring their pioneering work on structuration theory, DeSanctis and Poole [6] were the first to insightfully probe and characterize both artifacts and the work environment within which they are applied. These authors introduced Adaptive Structuration Theory (AST) and a framework anchored on its tenets which assesses the role of IT artifacts from two vantage points: (1) the types of structures that are provided by advanced technologies, and (2) the structures that actually emerge in human action as people interact with these artifacts. DeSanctis and Poole's [6] work not only allows the assessment of each sets of attributes independently but also permits the assessment of interaction effects between these sets of attributes (i.e. the mutual influence of artifacts and social processes) [12]. Drawing from Giddens [13], DeSanctis and Poole [6] first posited the concepts of social structures embedded in technology and social structures in action, and then considered the interplay between them [12]. The concept of social structures embedded in technology is crucial to the characterization of IT artifacts, and includes two dimensions: "structural features" (i.e. specific types of rules and resources, or capabilities, offered by the system) and "spirit" (the general intent with regard to values and goals underlying a given set of structural features) [6].

More recently, Markus and Silver [12] refined DeSanctis and Poole's [6] work in an attempt to address the criticisms made to the concepts of "structural features" and "spirit" as well as to account for the following two observations: (1)"variations in the social structures in technology were seen as encouraging different forms of social action", and (2) "the ways in which people actually used the social structures of technology (i.e. appropriated them) were seen as influencing the outcomes actually observed" [12, p. 612]. More precisely, Markus and Silver noted that people might appropriate a system's features faithfully (i.e. in a manner consistent with the spirit and structural feature design) or unfaithfully, leading to different consequences [5]. As such, Markus and Silver [12] suggested to unpack DeSanctis and Poole's [6] concepts and to redefine them as three new concepts: technical objects, functional affordances, and symbolic expressions. The technical objects concept pertains to the artifacts themselves whereas the functional affordances and symbolic expressions concepts refer to relations between technical objects and users. Specifically, the term "technical objects" refers to artifacts and their components, while the term "functional affordances" refers to the possibilities for goal-oriented action afforded to specified user groups by the technical objects and the term "symbolic expressions" refers to the communicative possibilities of a technical object for a specified user group. A key element in this reconceptualization is the establishment of a link between artifacts and their potential users through functional affordances and symbolic expressions. As a result, the interactions between artifacts and users can now be more clearly defined.

However, despite DeSanctis and Poole's pioneering work, little empirical research has been undertaken to test and validate their theoretical assertions and evaluate the influence of IT artifacts on users. As a result, few schemes are available to provide a sound theoretical grounding for further research. An exception is Rosen and Purinton's [14], empirical study which is based on Kaplan and Kaplan's [9] preference framework, and which theorizes and operationalizes the relationships between Web site features and users. Indeed, it is interesting to note that although Kaplan and Kaplan [9] did not explicitly build their framework on the tenets proposed by either Markus and Silver [12] or DeSanctis and Poole [6], the similarities between the different approaches are striking and provide a sound setting for future research

B. Kaplan and Kaplan's Preference Framework

The "Preference Framework" developed by Kaplan and Kaplan [9] is based on knowledge in psychology, architecture and design. Its basic premises are that artifacts provide users with information (i.e. signs, icons, etc.) and that this information inscribed in artifacts influences theirs behaviors. The influential role of inscribed information in artifacts lies in the assumed informational needs of individuals that are triggered when they interact with artifacts. In other words, Kaplan and Kaplan's [9] "Preference Framework" describes how individuals use the information inscribed in an artifact's design to satisfy their informational needs when interacting with it. As such, the "Preference Framework" is congruent with the tenets proposed by Markus and Silver [12] and DeSanctis and Poole [6] since it recognizes not only the characteristics of the artifacts (i.e. the information inscribed in them) and the characteristics of the users (i.e. their informational needs) but also their mutual interaction by assessing the fulfillment or not of the individual's informational needs. Put differently, by identifying and defining the fulfillment of needs, Kaplan and Kaplan [9] acknowledge the critical role of affordance and symbolism in linking artifacts to individuals.

Kaplan and Kaplan's [9] "Preference Framework" is rooted in a sequence of studies that asked participants to look and assess photographs of physical landscapes and landmarks against a list of items. Through these experiments, the researchers were able to categorize individuals' informational needs when interacting with artifacts along a cognitive and a time dimension, resulting in a 2x2 matrix of informational needs (see figure 1). The cognitive dimension reflects the different types of needs that compose individual informational needs while the time dimension captures the order in which informational

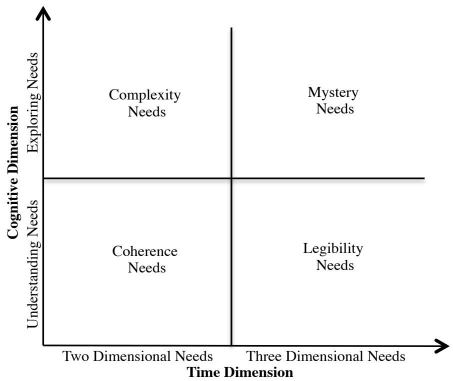

Figure 1. Kaplan and Kaplan's Preference Framework.

needs arise in an individual. More precisely, Kaplan and Kaplan suggest that an artifact can create understanding and exploring individual information needs which arise sequentially according to their assessment of immediate (i.e., two dimensional needs) versus longer-term (i.e., three dimensional needs). As such, four different informational needs exist (i.e., coherence, complexity, legibility and mystery), each representing a certain type of need (understanding vs. exploring) at a certain time (two vs. three dimensional).

Kaplan and Kaplan's preference framework posits that an individual's IT artifact usage behavior stems from the sequential fulfillment or not of his informational needs. As such, the behavior of an individual is first defined by the fulfillment of his immediate needs (i.e. two-dimensional needs) which arise from the instantaneous interaction with an artifact. As seen in table 1, these are coherence and complexity informational needs, which, when fulfilled, allow an individual to proceed to a rapid assessment of an artifact based upon a relatively superficial examination. Coherence informational needs refer to the degree to which the artifact features hang together. Thus, coherence needs can be fulfilled through the redundancy of the artifact's elements and/or textures, where, for example, the coordinated elements of an IT artifact give it a "minimalist" feel since few colors and elements are integrated in its design (e.g., Motorola MOTOPHONE3). On the other hand, complexity informational needs refer to the richness of the artifact features. For example, in a smart phone, the number of buttons or colors on the keyboard, the variety of icons available on the screen, the array of hands-free functionalities, amongst other things, would all contribute to the complexity of the artifact. It is important to note that both coherence and complexity informational needs must be fulfilled first for an individual to follow his course of action when interacting with an artifact.

Subsequently, an individual's usage behavior will be dictated by the fulfillment of longer-term needs (i.e., three-dimensional needs). These are legibility and mystery informational needs. Legibility informational needs refer to whether or not an artifact possesses a memorable component, a landmark facilitating the finding of one's way. This is similar to having a menu bar that is always positioned at the bottom of the screen no matter which application is used in a smartphone or PDA. Mystery informational needs refer to the extent to which an artifact conveys the feeling that many more features can be found. A smartphone could, for example, prompt users to discover new functionalities through certain feed-forward or feedback information.

Kaplan et al. [15] equated the transition an individual makes between immediate and longer-term needs to moving from a two-dimensional space to a three-dimensional space or as the difference between standing at the gate of a garden and actually walking through the garden. Finally, Kaplan and Kaplan's [9] "Preference Framework" implies that individuals will have a preference for artifacts that fulfill all four informational needs, an assumption that has been validated by several researchers who showed that people favor artifacts that answer coherence and legibility informational needs [16], while at the same time accommodating a desire for some complexity [17] and mystery [24].

C. Mobile IT Artifact Features

The notion of features, although well defined at the conceptual level (i.e. the building blocks or component parts of a technology [19]) remains rather elusive at the operational level. Recognizing this conundrum, Griffith [19] suggested that it is only through theoretical anchoring that researchers will be able to rightfully operationalize the concept of artifact features. Therefore, because individuals interact with artifacts through their senses [20] and because this study focuses on the interactions between mobile IT artifacts and their users, the present study defines features at the sensory level. That is, any building block or component directly triggering one of the five human senses (i.e., sight, hearing, smell, touch, and taste) is considered to be a feature.

Mobile IT artifact features have traditionally been investigated along three dimensions: (1) visual, (2) tactile and (3) audio [21], since smell and taste features have yet to be effectively developed and incorporated into m-commerce artifacts. In general, visual features have been the main focus of m-commerce and IS researchers. Findings from these research initiatives underline the significant impact of visual features on user behaviors and perceptions. For example, Karvonen [22] found a relationship between "aesthetic beauty" and e-trust. Rosen and Purinton [14] found that minimalist visual design drew users further into their task and increased perceived artifact efficiency. Furthermore, although early studies which thought that individuals perceived an artifact's visual informational cues in a holistic manner [23], recent findings from Lavie and Tractinsky [24] demonstrate that online users perceive visual informational cues along two sub-dimensions, namely classical aesthetics and expressive aesthetics. The first sub-dimension is associated with clean and orderly design, while the second represents the originality and creativity of the artifact's design, as

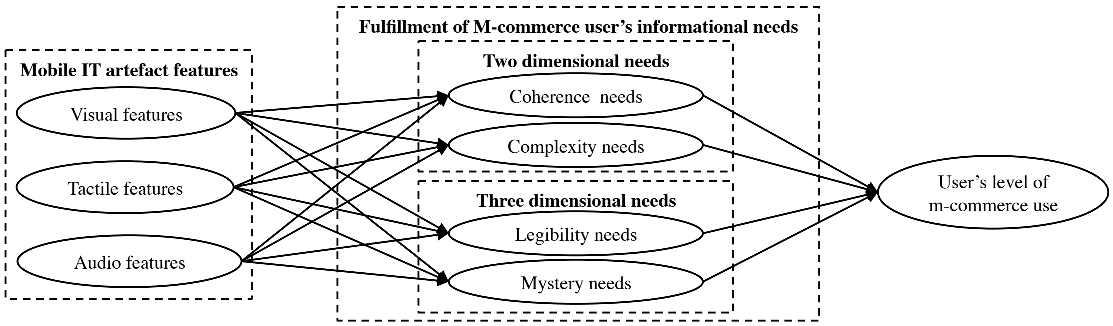

Figure 2. Research Model.

perceived by the users [24]. Altogether, these findings on visual features are in line with Kaplan and Kaplan's [9] framework, which identifies similar perceptual factors in the dimensions of coherence and complexity, and recognizes individual perceptions of artifacts to be multidimensional [25].

In addition, just as Kaplan and Kaplan [9], Tractinsky and Lowengart [25] acknowledged that while these sub-dimensions are distinct, they are not necessarily orthogonal. More precisely, Tractinsky and Lowengart [25] argued that "conceptually, the correlation between the two sub-dimensions reflects a fundamental relation to aesthetic design and perceptions" and that empirical correlations amongst the sub-dimensions "reflect an ecological phenomenon in which capable designers are good at creating balanced designs high on both sub-dimensions, whereas incompetent Web design tends to fail on both". These findings regarding visual features reinforce Kaplan and Kaplan's [9] assertion that individuals will prefer artifacts, which fulfill all four informational needs. However, although the strong emphasis on visual features has brought important insights on these specific characteristics of artifacts, this unbalanced attention has also meant that the IS field has to some extent neglected the study of tactile and audio features. Such features are also important as interaction effects across various features may also have significant impacts on users [19]. Furthermore, insights from the literature on virtual environments suggest that while adding auditory and tactile cues are likely to increase a user's perception in doing a certain task, increasing the level of visual fidelity will not produce similar outcomes [26]. Such findings suggest a potential tradeoff between features and limitations to feature enhancements (i.e., more is not always better). Therefore, a thorough investigation of all mobile IT artifact features and not just their visual characteristics is needed to better understand their role and influence on individuals.

III. Conceptual Framework

A. *Research Model*

As described above, Markus and Silver [12] have theorized that IT artifacts influence users through their functional affordances and symbolic expressions. On the other hand, Kaplan and Kaplan [9] provide an operationalization of these concepts by defining the linkages between an IT artifact's features and an individual's behaviors through IT artifact informational cues and their fulfillment of informational needs. Based on these ideas, the following research model and related hypotheses are proposed (see figure 2)

B. *Hypotheses*

1) *Two vs. three dimensional informational needs*

Individuals are believed to depend on their visual sense for 80% of their external information, and presumably for even more than 80% of their external information when working with a GUI [27]. As such, visual features of mobile IT artifacts, which are likely to fulfill most of the informational needs, are extremely important when individuals are first introduced to the technology. However, such an unbalanced reliance on visual informational cues can heavily tax an individual's sense of vision and render the conveyance of additional information through this specific sense more difficult [28]. Consistent with this idea, Huong et al. [26] found that visual informational cues, although more important then tactile and audio informational cues, were in fact limited in their impact on users due to visual saturation and limited computational power. As such, several researchers have suggested [29], and have empirically validated [28] the idea that other senses should also be put to contribution to overcome the limits of visual informational cues. Results from these studies showed that adding tactile and audio feedback while users interact with IT artifacts did in fact increase their performance. As such, and based on the fact that individuals heavily rely upon visual informational cues, visual features are likely to play a more important role in fulfilling an individual's two-dimensional needs than tactile and audio features. However, since an individual's visual sense is already heavily taxed, leaving limited room for additional informational cues, tactile and audio features are likely to fulfill three-dimensional needs more effectively than visual features. These arguments lead to the first two hypotheses.

Hypothesis 1: The relationship between visual features and the fulfillment of an individual's informational needs will be stronger for two dimensional needs than three dimensional needs in both adoption and post adoption settings.

Hypothesis 2: The relationship between audio and tactile features and the fulfillment of an individual's informational needs will be stronger for three dimensional needs than two dimensional needs in both adoption and post adoption settings.

2) *Adoption vs. post-adoption informational needs*

In developing their preference framework, Kaplan and Kaplan [9] recognized that individuals assess new situations and the information available to them in a two-phase, sequential manner. At first, individuals reflect on their immediate and direct perception of the setting's elements. These initial preoccupations are translated into coherence and complexity informational needs that must be fulfilled for the individuals to feel at ease in their novel environment and to follow their course of action. This primary assessment is subsequently followed by a secondary appraisal which emphasizes deeper needs (i.e. legibility and mystery informational needs) [14]. In order words, individuals move from a two-dimensional space, where coherence and complexity informational needs are pre-dominant, to a three-dimensional space, where legibility and mystery informational needs prevail [15].

As such, the sequential manner in which individuals assess a new situation suggests that the importance of each informational need evolves over time and that their influence on individuals varies accordingly, with two-dimensional needs being more important at first, and three-dimensional needs being more important later on. This idea was empirically supported by Rosen and Purinton [14] who used Kaplan and Kaplan's [9] preference framework to assess the quality of website design. More precisely, these authors demonstrated that two-dimensional needs were more important than three-dimensional needs when individuals were first introduced to a new website. Their results showed that users' intentions to revisit a web site after a brief initiation were largely explained by coherence (30.59% of variance explained) and complexity (20.87 % of variance explained) informational needs than legibility (17.8 % of variance explained) and mystery (not significant) informational needs. Thus, two-dimensional needs are likely to be more important for adopters who have limited experience with mobile IT artifacts than for experienced users (i.e., post adopters). Conversely, and again because of differences in experience with using mobile IT artifacts-commerce device, three-dimensional needs are likely to be more important for post adopters than for adopters. These arguments lead to the last two hypotheses.

Hypothesis 3: The relationship between the fulfillment of an individual's two-dimensional needs and his level of use of mobile IT artifact features will be stronger for adopters than for post adopters

Hypothesis 4: The relationship between the fulfillment of an individual's three-dimensional needs and his level of use of mobile IT artifact features will be stronger for post adopters than for adopters.

IV. METHODOLOGY

A. *Data Collection*

To empirically test the proposed research model we propose to investigate the rollout of an m-commerce solution to a group of pilot users within a company for a one-year period. Two surveys will be administered, one at the beginning of the rollout, after an initial training session, and another at the end of the project. The surveys' instruments will include measures drawn and/or adapted from the literature as well as measures that will be specifically develop for the purpose of this study. At each data collection point, users will be asked about their level of use of mobile IT artifact.. Users will also be interviewed on their informational needs and the features that enable them to fulfill these needs.

B. *Statistical Analyses*

Structural equation modeling (SEM) will be used to analyze the study data. As such, for each of the two data collection, a two-phase analytical procedure will be employed. In the first phase, a confirmatory factor model (i.e., the measurement model) will be used to measure the fit between the theorized model and observed variables, whereas the results of the measurement model will be used to create a path-analytic model to investigate the relationships hypothesized between the study constructs in the second phase [30]. Subsequently, we'll rely on the procedure proposed by Karahanna et al. [31] to compare the results from the two surveys, identify differences and test the research hypotheses.

V. CONCLUSION

The present research aims to answer the following research question: "Why does the usage of mobile IT artifact features vary over time?" and to validate the premise that individuals use different features at different points in time because the information inscribed in mobile IT artifact features is stable and their informational needs evolve over time. To do so, we propose a research model anchored on Kaplan and Kaplan's [9] preference framework to test the influence of mobile IT artifacts features on the behavior of m-commerce adopters and post adopters. The results obtained are expected to provide important theoretical and practical contributions.

First, this study departs from previous research in the IS field by being one of the few to open the IT artifact black box and to empirically investigate the role of IT artifact features on individual behaviors. As such, the present research, which defines IT artifact features along three dimensions (i.e., visual, tactile, and audio), will improve our understanding of concrete and tangible technology acceptance's antecedents. Second, the longitudinal stance of this study that will permit an

 ISBN: 978-1-61208-329-2

assessment of the varied influence of IT artifact features over time is likely to provide additional insights on the influence of time and IT artifact features on individuals' behaviors. Third, this research relies on a different theoretical lens than the traditionally used TAM framework and as such can contribute to the IS field in validating and providing IS scholars with a new research tool.

From a practical standpoint, the proposed study can help managers to better design and manage m-commerce apparatuses and improve the various outcomes tied to their use. For example, anticipated insights from this study could suggest that training to novice users should focus on visual features while training to experienced users should focus instead on tactile and audio features. Also, if practitioners plan to implement upgrades to the m-commerce devices used in their organizations, insights from this study can inform them on which features to upgrade and at what time in each apparatus' life cycle. Such guidance can be of significant importance as upgrading IT artifact features often entail tradeoffs and represent significant investments in both time and money [26].

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