TAM: A Reference Model For Mobile Cash Adoption

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ABSTRACT
Several theories of adoption models have been developed. All of them have different constructs depending on their application. Select a model is a difficult task because all of them have strong behavioural elements. In this paper a method of model selection is presented. The method was applied in order to select the most suitable model for an application related to device "Mobile Cash" technology. The method is based on four steps that are described in detail. The adoption models were evaluated based on eight criterions. In this article, shall be discussed each behavioral model such as TAM, IDT, TPB among others, and as a result the TAM model was selected. Finally, a model for Mobile Cash Adoption using TAM is present.

CCS Concepts
• **Information systems applications→Mobile information processing systems**

Keywords
"Mobile cash", "electronic payments", "TAM", "innovation"

1. INTRODUCTION
The communications revolution, thanks to the Internet, has made business to boost and the economy to accelerate. According to [1] has been a 50,1% penetration of the Internet, and from 2000 to 2016 at the level of Latin America has been 384,751,302 Internet users. The organizations adopt Information and Communications Technology (ICT) in order to support their business activities. One sector that has seen technological innovation both from the end user and organizational perspectives is the banking sector [2]. The banking sector is changing the way it interacts with customers and how they access financial services.

Mobile banking is considered as an approach for providing financial services through ICT which facilitates the selection of mobile services in even low-income countries [3]. Mobile banking is considered as the latest in a series of recent mobile technological wonders [4]. In particular, the expanded use of smartphones has increased demand for mobile banking [5] and the younger people are particularly interested in mobile banking [6]. In Perú two banking entities have launched a service that, through

text messages, money can be transferred to people without contacting the bank. This service allows the clients of those entities to transfer cash to any person, including those who have no contact with products in the financial system. This service has been called Mobile Cash. Mobile cash is a mobile banking service, which, in spite of the advantages it offers to users, its use has not been widespread. Also, a study has to be conducted in order to evaluate the acceptance of the intended use of the mobile cash.

According to [7] [8] the adoption and diffusion of ICTs greatly influence nations' economic growth and postponing technology usage has negative effects. Several theories and models of technology acceptance have been developed. The purpose is to explain consumers' product and service adoption [9]. Among them, the diffusion of innovations theory [10], the theory of planned behavior (TPB) [11], the theory of acceptance model (TAM) [12] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [13] are the most significant ones. Each model report several adoption enablers and inhibitors related to perceptions such as performance expectancy or perceived ease of use [9]. However, the task of selecting the adoption model that best fits the organization's needs is a difficult task and requires the knowledge, skills and experience. This work contribution is a set of criteria and a method for assessing candidate's adoption model. In this paper, we present a method for selecting a model adapted from [14] for behavioral study. The aim is to determine which factors and thus allow the insertion of "Mobile Cash" product on the market.

Identifying factors for the intended use of Mobile Cash condition the study to determine a model of technological acceptance. So, it is necessary to classify the selection criteria, which are determined by different terms and different authors in each application of electronic banking. Factors such as security, usability, reliability, ease of use and others should be considered within the criteria. It is, therefore, necessary to determine a method to identify the criteria and maintain a standard language selection.

This article is organized as follows: Section 2 the context of the research is presented, in Section 3 presents the method to select a reference model. Section 4 presents the application of the method to the deployment process. Finally, Section 5 presents the conclusions.

2. BACKGROUND
Several theories have been developed in order to explain the adoption of services and product adoption. They report several adoption enablers and inhibitors that are mainly related to perceptions of technology attributes (e.g., performance expectations and perceived ease of use), users'/non-users' characteristics (e.g., innovativeness and technology readiness) [9].

The process "diffusion of innovations" was defined by Rogers which is based on the study of people who adopt innovations. Rogers is developing a model for marketing and innovation related to the process of adoption studies. The model describes the process of innovation adoption, implementation and use in five steps: knowledge, persuasion, decision, implementation and confirmation [10].

Several theories and models of technology acceptance have been developed in the last 30 years by different authors. Among the most important models are: Innovation Diffusion Theory (IDT), Theory of Reasoned Action (TRA), Social Cognitive Theory (SCT), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), Motivational Model (MM), Technology Acceptance Model 2 (TAM2), Unified Theory of Acceptance and Use of Technology (UTAUT). The term "acceptance" in the literature does not have a single definition. Davis describes [13] the acceptance as a user decision about how and when they will use a certain technology.

According to the Theory of Diffusion of Innovations (IDT), innovations have five key characteristics that determine their adoption [10]: relative advantage, compatibility, complexity, divisibility and observability. Based on the proposed Rogers suggested a modification of the innovation characteristics applied to the adoption of information systems and defining seven own innovations and conditions of its adoption characteristics, keeping the relative advantage, compatibility and divisibility, to which they added four new: ease of use, image and results demonstrability.

The theory of Reasoned Action (TRA) has its origin in social psychology, whose aim is to study the origin and development of conscious and intentional behaviors [15], [16] as well as attitudinal behavior components, trying to answer the question of what motivates people when making their behavior in reality.

The Social Cognitive Theory (SCT) is rooted in the psychology of learning, and part of the claim that the individual's knowledge is directly influenced by observing the behavior of others [17]; well, these behaviors can guide you to allow individuals to act on the symbolic constructions, product of observation [17]. SCT is composed of three elements: personal factors are the individual traits that characterize an individual, behavior or way of acting of a person and environmental factors represents all that is not intrinsic to a person.

Theory of Planned Behavior (TPB) appears as an extension of TRA to overcome the limitations it presents to unaware or voluntary behaviors. TPB introduces a key factor called perceived behavioral control in order to offer a better prediction behavioral intention and behavioral [18].

Technology Acceptance Model (TAM) is proposed by Davis as an amendment to the TRA, but reducing the scope of this in order to be able to predict behavior, acceptance and intended use technologies by individuals. More specifically, the first studies of Davis focused on the acceptance by users of computers and information systems [19]. TAM was designed to evaluate the technology acceptation of Information Systems. TAM includes two variables Perceived Usefulness and Perceived Ease of use.

Technology Acceptance Model 2 (TAM2) is considered the model has been sufficiently proven, but it should include many of the factors proposed in the previous stage. The result of this synthesis is proposing a development model called TAM2 [20], which preserves the original factors, which adds the regulatory factors (subjective norm, voluntary use) and affective -image understood as "the degree to which an individual perceives that innovation contributes to enhance their social status [21], as well as factors related to cognitive aspects of individual relevance for the task, output quality or degree of goodness of the results provided by the system, experience with the system and provability of results.

Technology Acceptance Model 3 (TAM3) mainly incorporates two novelties, introduce the concept of factors anchoring and adjustment factors as a means to explain the background of the perceived ease of use. Thus anchoring factors are those that appear naturally in each individual's belief personality inherent to the use of technologies, or a concrete-technology [22].

Decomposed Theory of Planned Behavior (DTPB) was raised by Taylor and Todd [23] to give an explanation to the determinants of the adoption of information technology to facilitate its implementation. DTPB was born as a result of unification between RTD and TPB, also relying on some constructs of TAM, perceived usefulness as-similar to the relative advantage for RTD and ease of use a concept opposite but equivalent to the complexity. Venkatesh, Morris and Davis [13] analyzed each previous model to establish a unified model which no longer present limitations and this was born the Unified Theory of Acceptance and Use of Technology (UTAUT).

3. SELECTING A MODEL

A method for selecting a model [15] has been adapted and applied in order to select a model of human behavior for mobile cash adoption. The study has been prepared in accordance with existing models and theories. The method comprises the following steps: (1) Step 1: Identify models of human behavior, (2) Step 2: Establish selection criteria based on research, (3) Step 3: Perform comparative analysis of the models and (4) Step 4: Select the model according to the research.

Figure 1 shows the stages, activities and products of the method. The following section explains each of these stages in detail. Each stage is described in three aspects; (1) The objective of the stage, (2) development of each activity and (3) the products of each stage. Next, is a description of each of the stages:

- Step 1: Identify models of human behavior: The purpose of this step is to identify all existing models of human behavior and name each of the variables and components that work. The steps are: (1) Define concept model, and (2) Identify the variables.
- Step 2: Establish selection criteria based on research. The purpose of this step is to define the criteria that allow to perform a comparative analysis of the models and / or standards. The criteria are selected according to: scope, popularity, focused on people, and limitations. Here are the steps to follow: (1) Ask the questions, considering the product under study and its scope, (2) Identify and select elements, (3) The comparison is based on prior knowledge of the problem and the need for information on the models or standards that form part of the analysis, and (4) Establish selection criteria: They establish the selection criteria, taking into account the questions asked and the identified items.
- Step 3: Perform comparative analysis of the models: The purpose of this step is to perform a comparative analysis of models and standards. Here are the steps to follow: (1) Review the structure of the identified models, (2) Set the detail level of the analysis, (3) Review the models and standards established at the level of detail and develop a summary matrix of information as a

result of the review, and (4) Record the results of the review in the comparative analysis matrix.

- Step 4: Select the model according to the research: The purpose of this step is to select the reference model based on the selection criteria and using the comparative

matrix analysis result of Step 3. Here are the steps to follow: (1) Check the actual values obtained for each model and the ideal expected reference value, and (2) Select the reference model.
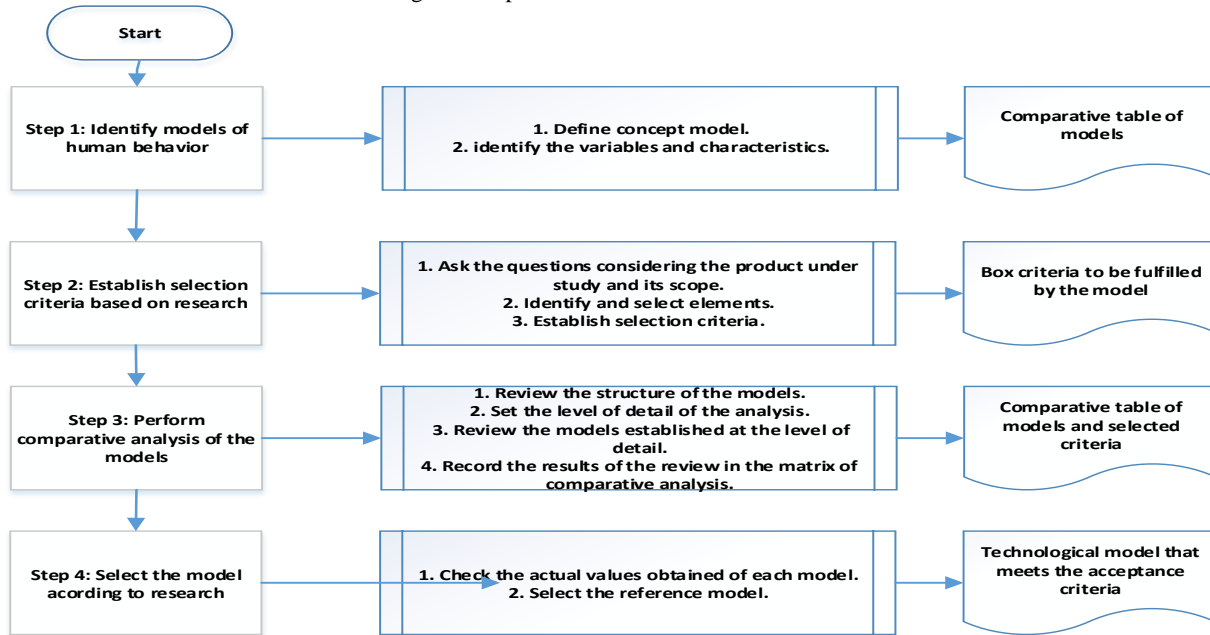

Figure 1. Selection Method Stages

4. APLICATION METHOD

4.1 Step 1: Identify Models of Human Behavior

The identified models were Theory of Diffusion of Innovations (IDT), Theory of Reasoned Action (TRA), Social Cognitive Theory (SCT), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), Technology Acceptance Model 2 (TAM2), Technology Acceptance Model 3 (TAM3), Decomposed theory of planned behavior (DTPB), Unified and Theory of Acceptance and Use of Technology (UTAUT). Table 1 shows the models of human behavior and their variables.

Table 1. Models of Human Behavior

Models / Theories	Variables
Theory of Diffusion of Innovations (IDT)	Relative advantage, Ease of use, Image, Visibility, Compatibility, Demonstrability results, Voluntariness
Theory of Reasoned Action (TRA)	Attitude towards act or behavior and Subjective norm
Social Cognitive Theory (SCT)	Performance Expectation, Effort expectancy, Auto efficiency, Affection, Anxiety
Theory of Planned Behavior (TPB)	Attitude, Subjective norm, Perceived Behavioral Control
Technology Acceptance Model (TAM)	Perceived Usefulness, Perceived Ease of use, External variables
Technology Acceptance Model (TAM2)	Subjective norm, Willfulness, Image, Experience, Job relevance, Output quality, Results Demonstrability
Technology Acceptance Model (TAM3)	Anxiety about technology, Satisfaction with technology, Efficacy against technology, Perception of enjoyment, Objective usability, Perception of external control
Decomposed theory of planned behavior (DTPB)	Utility, Ease of use, Compatibility, Influence of equal, Influence of high, Auto effectiveness, facilitating resources, Facilitating technology
Theory of fit between task and technology (TTF)	Tasks, Technology characteristics, Individual characteristics
Unified theory of acceptance and use of technology (UTAUT)	Performance expectancy, Effort expectations, Social influence, Facilitating conditions

4.2 Step 2: Establish Selection Criteria Based on the Research.

At this stage we try to answer the following questions.

- What features and what aspects of the process need support to achieve our goals?
- What models and / or improved standards facilitate or enable the desired characteristics?

For proper selection of the model to the analysis, the study in question defined a series of criteria to analyze, as scope, popularity, scope, if you study behavior, limitations, variables useful variables of usability and external variables.

- C1: Range selection criterion serves as a reference for model application.
- C2: Popularity selection criterion serves as a reference that if the model is known or has greater resonance.
- C3: Scope selection criterion serves as a reference model that can be applied in various types or a specific one.
- C4: Focus selection criterion serves as a reference to the model that is dedicated to a human study.
- C5: Limitation selection criterion serves as a reference to the model that has restrictions.
- C6: Variable selection criterion is that income is a requirement that this model has this variable.
- C7: Variable selection criteria Ease of use are that it is a requirement that this model has this variable.
- C8: The selection criterion is that external variables are a requirement that the model allows to add more variables.

4.3 Step 3: Perform Comparative Analysis of the Models

Each of the models identified against each of the defined selection criteria. The information collected was stored in a matrix that summarizes information on the model, the selection criteria, the level of detail, the detailed description of activities related to each criterion and coverage model to that criterion.

4.4 Step 4: Select the Model According to Research

Comparative matrix models and model coverage for each of the criteria are reviewed. As a result of analysis of the values in the matrix of comparative analysis of models, it is concluded that most of the models under study addresses it partially and in some cases are the only references. After defining the selection criteria for the analysis model is performed as shown in Table 2, from which the Technology Acceptance Model (TAM) meets the eight criteria. To perform the evaluation, the results were weighted in the following manner: (1) If the value of the model that is being evaluated is equal to the ideal, the value is one, and (2) if the value of the model that is being evaluated is any other value, was considered zero.

The selected software was TAM. IDT meets the C1, C3, C4 criteria because the scope is focused on innovation and technology and there are not many applied studies related to banks. TRA meets the criteria C4, C5 because of its significance and evolution in the model but does not have a technological scope, and the mobile banking application. The column "EV" represents the frequency.

TAM meets all the criteria as it has support for applying the technology model issues and behavior analysis is the most complete. The TAM model selected will be used as proposed for the study of the mobile cash model. This model permits within its definition to add new variables to identify the relationship between the variables and so finding the best model with the variables proposed.

Table 2. Comparative Models

Models / Theories	C1	C2	C3	C4	C5	C6	C7	C8	EV
Theory of Diffusion of Innovations (IDT)	√	X	√	√	X	X	X	X	3
Theory of Reasoned Action (TRA)	X	X	X	√	X	X	X	X	1
Social Cognitive Theory (SCT)	X	X	X	√	X	X	X	X	1
Theory of Planned Behavior (TPB)	X	√	X	√	√	X	X	X	3
Technology Acceptance Model (TAM)	√	√	√	√	√	√	√	√	8
Technology Acceptance Model (TAM2)	√	√	X	√	√	X	X	X	4
Technology Acceptance Model (TAM3)	√	√	X	√	√	X	X	X	4
Decomposed theory of planned behavior (DTPB)	X	X	X	√	X	√	√	√	4
Theory of fit between task and technology (TTF)	√	X	√	√	√	X	X	X	4
Unified theory of acceptance and use of technology (UTAUT)	√	√	√	X	X	X	X	X	3
Ideal Model	√	√	√	√	√	√	√	√	8

The results obtained show that TAM is the selected model. According to [5] TAM is very popular as a framework for examining intentions to adopt mobile banking. This model has been used in a variety of studies to explore the factors affecting individual's use of new technology [24]. TAM has been applied in numerous studies of technological acceptance. Among them we can mention: text processors, spreadsheet applications, email, web browsers, websites, and so on. The variables considered for the proposed model of acceptance are: ease of use, perceived risk and safety, intention to use, ease of use, perceived confidence, compatible lifestyle and Risk and perceived security. Figure 2 presents a model from the selected TAM model. H1a, H1b, H1c, H2, H3a, H3b, H4, H5 and H6 are the hypothesis.
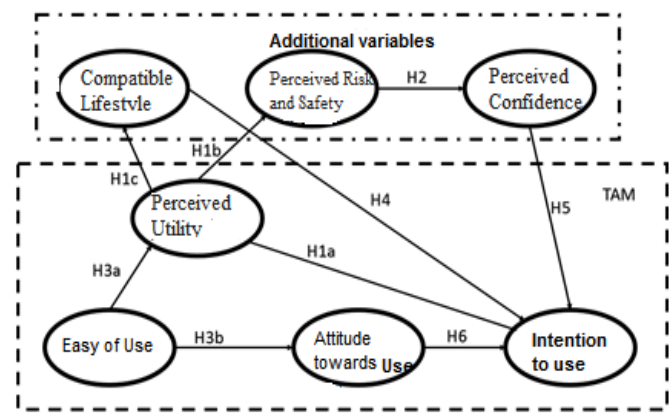
Figure 2. Model for Mobile Cash Adoption using TAM

5. CONCLUSIONS

Different models aiming to study human behavior have been developed over the years. To select the model that best suits the needs of the study is a difficult task. It requires knowledge about the environment where it will be developed. The proposed method allows you to select a reference model for the application to study with a set of predefined criteria, in accordance with the priorities and needs of the environment under study. It also provides criteria that can be used for further research when they have to choose the model for human behavior of Mobile cash. The contribution of this work is a set of criteria and a method for assessing candidate models. In order to test this method selection, several acceptance models were examined. TAM was the method selected because: about the constructs, there is no absolute measure to ease of use or usefulness, user perceptions of these constructs may vary with time and experience for any given application, technology innovation and frequent use are important elements. As a future work an adoption model for mobile cash based on TAM is proposed and will be validated.

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