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Modeling users' acceptance of mobile services

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Abstract The success of mobile services adoption hinges on their ability to cover user needs and attract consumer interest. The extant literature focuses on understanding the factors that might affect consumers' actual adoption of such services through their effect on behavioral intention; these studies are mostly based on behavioral intention theories, such as Technology Acceptance Model, Diffusion of Innovation and Unified Theory of Acceptance and Use of Technology. In this work, new theoretical constructs are combined with existing evidence in order to extend the Technology Acceptance Model (TAM) as it was initially established by Davis and later further enriched by other researchers. The proposed model includes behavioral intention, perceived usefulness, perceived ease of use, trust, innovativeness, relationship drivers, and functionality. Within this approach, relationship drivers introduce a marketing perspective to the original models of technology adoption by building emotional connections between the users and the mobile services. The hypothesized model is empirically tested using data collected from a survey on m-commerce consumers. Structural Equation Modelling (SEM) was used to evaluate the causal model and Confirmatory Factor Analysis (CFA) was performed to examine the reliability and validity of the measurement model. It is briefly concluded that behavioral in-

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tention is directly affected by perceived usefulness, innovativeness and relationship drivers; the findings provide interesting insights and useful hints to practitioners and researchers.

Keywords Mobile services acceptance · Innovativeness · Trust · Relationship drivers · Functionality · SEM

1 Introduction

The mobile era is already established. The mobile devices manufacturers can be proud of their retailing, as in five years the number of smartphone users has grown from 5 % to 20 % [37]. The statistics, also, show that the mobile traffic had an average of 108 % annual growth [37]. These numbers give mobile applications and mobile services a very prosperous future.

A number of industrial and academic researches have been conducted around the field of mobile services. The mobile data services mainly refer to the communication services (e-mails, SMS, MMS, etc.), web information services (weather information, sports, banking information, news, etc.), database services (telephone directories, map guides, etc.), entertainment (ringtones, videos, games, etc.) and commercial transactions through the mobile devices (buying products, making reservations, banking, stock trading, etc.) [46, 51, 66]. Exceptional recognition have also received the location-based services, especially when it comes to emergency cases of a healthy or a governmental issue [4, 55].

A basic research question is whether these services are worth being used by the wide part of the population or not. A first impression would be that they are quite popular since the statistics show that the mobile phones in Greece have a high penetration degree (146 %) [7]. Surveys show, however, that in spite of the high penetration rate, 4 out of 5 Greeks have never used any of the aforementioned services, whereas the majority of the users seldom utilize such services [36]. So, it is a big challenge to find those specific attributes of the mobile services that still keep them rather unpopular in Greece given the wide adoption of mobile devices. It is an even bigger challenge, though, to find possible solutions and make suggestions regarding the set of factors that affect their adoption. The aim of the paper is to find out users' reaction towards different parameters that would influence the individual's intention to use the mobile services in the current Greek reality.

There are several behavioral intention theories. The most popular and widely used ones are following. The Diffusion Of Innovations (DOI) perspective is introduced by Rogers [58] investigating a variety of factors which are considered to be determinants for the actual adoption and usage of Information Systems. According to DOI, potential adopters evaluate an innovation based on innovation attributes (relative advantage, compatibility, complexity, trialability and observability) ([58], p. 16). The Theory of Reasoned Action (TRA) was first proposed by Fishbein and Ajzen [26] and it supported that users' intention to adopt a technology is determined by two factors: personal in nature (attitude) and social influence (social or subjective norm). TRA was later evolved to the Theory of Planned Behavior (TPB) by adding perceived

behavioral control to the initial determinants [1]. The TPB was also enriched with stable, decomposed beliefs structures for the TPB model and proposed the Decomposed Theory of Planned Behavior [63]. Finally, the Technology Acceptance Model (TAM) indicates that perceived ease of use and perceived usefulness are the two main beliefs that determine one's intention to use technology [20]. The most recent one, however, is the Unified Theory of Acceptance and Use of Technology (UTAUT). Venkatesh et al. [67] combined eight models (the above theories' models plus a few of their extensions) in a unified technology acceptance model, which contains five determinants (performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intention). It is used so far for a number of technology types such as e-government [2], wireless LAN [5] and m-commerce [54].

Although TAM is negatively criticized by a team of researchers, it compares favorably to TRA and TPB [25]. When deeper explanation of user adoption intention is desired, it allows other factors to be incorporated easily into its basic model [34]. Hence, in the current study, we keep the basic variables of TAM—perceived ease of use, perceived usefulness and behavioral intention—and through literature research we contribute with new variables—trust, innovativeness, relationship drivers and functionality—which are expected to have influence on the mobile services adoption intention. All these constructs in this paper, are defined in a strict mobile context (trust, for instance, is used regarding the different mobile data services dimensions). Taking Turner's research [65] into consideration—which in most of the cases verifies that TAM can adequately predict the adoption of a new technology—the objective of this study is to predict the mobile services adoption through behavioral intention when specific factors co-exist. The study suggests a conceptual model, which, as an entity that includes different constructs, influences the adoption intention towards the above services. Such a study in the mobile domain has not yet been investigated in Greece.

Consequently, the contribution of this article is multi-sided: First, the article contributes to the development and evolution of a theoretical and conceptual model for examining its effect on mobile services usage intention; it builds on the growing literature of the technology acceptance models. The concurrent combination of innovativeness, trust, functionality, and relationship drivers as parameters of the same model to predict the users' decision to adopt a new service has not been tested before in the literature. Most of them—as they are analyzed in the next section—have been examined separately, or as parts of other conceptual models; this survey's model is newly suggested. Additionally, this new technology acceptance survey is conducted in a country, where scarce similar studies have taken place; the results might be unexpected and contradicted with other international surveys' outcomes. Finally, the article uses perspectives from the marketing area for a technology acceptance issue by including the relationship drivers construct. It combines ideas from the relationship marketing with the unique characteristics of the mobile technologies. The idea of correlating the adoption intention of the m-services with the relationship ties that are possible to be created by their own use is quite innovative and very specialized in the mobile features of the considered technology.

The paper is organized in four sections. In Sect. 2, there is an explanation of the hypotheses formed based on literature review and the description of the constructs that

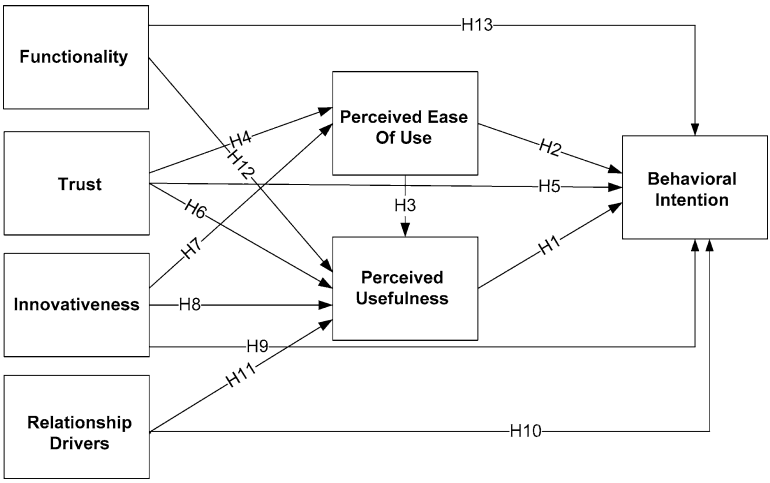

Fig. 1 Initial conceptual model

are included in the theoretical model. It is followed by Sect. 3, which describes the applied methodology and presents the survey's results. The final section concludes with a discussion commenting on the results and recommends some ideas for future research directions.

2 Literature review and hypotheses development

A survey research is conducted using a questionnaire to examine the factors that affect the users' behavioral intention to adopt mobile services. Based on the literature review, a conceptual model including the initial hypotheses is formulated (Fig. 1). The model consists of the following variables (Table 1): Behavioral Intention, Perceived Usefulness, Perceived Ease of Use, Trust, Innovativeness, Relationship Drivers, and Functionality. In this section, the variables are explained, and the related hypotheses are developed.

2.1 Behavioral intention

In most of the well-established models of behavioral intention theories, such as the Technology Adoption Model (TAM) and the Theory of Reasoned Action (TRA), there has been an attempt to examine the factors that affect the consumers' decision on using a technology studied [72]. Fishbein and Ajzen [26] first defined the term "Behavioral Intention" to depict "a person's subjective probability that he will perform some behavior". Davis, also, follows up with this idea to give shape to TAM [20], which finally concludes to the "Actual System Use". Based on these concepts, in the paper herein, there is a construct included in the proposed model entitled "Behavioral Intention" to describe a person's subjective probability that he or she will perform mobile data services.

Table 1 The conceptual definitions of the research variables

Research variables	Conceptual description	Reference
Behavioral Intention (BI)	"A person's subjective probability that he or she will perform some m-services"	[26]
Perceived Usefulness (PU)	"The degree to which a person believes that using m-services would enhance his or her job performance"	[20]
Perceived Ease of Use (PEOU)	"The degree to which a person believes that using m-services would be free of effort"	[20]
Trust (TR)	– security in mobile payments – confidentiality of personal data – trustworthiness in the results of the m-services – integrity of the terms of use of the m-services	[12, 18, 19, 48, 53, 71]
Innovativeness (INN)	"The willingness of an individual to try out any new information technology"	[47]
Relationship Drivers (RD)	– time and location personalization of the m-services – the services' adaptation to the consumers' profile – the consumers' dynamic permission option	[14, 24, 38, 48, 52, 75]
Functionality (F)	– transaction speed (response time) – connection to the network speed – interface comprehensibility – infrastructure availability	[15, 21, 22, 39, 40]

2.2 Perceived usefulness

"Perceived usefulness" has been an instrumental construct in many of the technology adoption models that have been proposed since 1989, when Davis first used this term. It is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" [20]. Perceived usefulness has been included as a construct in a number of surveys for different types of technologies and systems, such as mobile payments [15], mobile commerce [48], mobile data services in China [57], application frameworks [56], eCRM [17], and generally, technology adoption models [35, 62, 69, 72]. In all the above studies, the perceived usefulness of the technology concerned influences positively individuals' adoption intention of this technology. Thus, it is reasonably expected that the same relationship between the model's constructs could also be applied to the present study. Therefore:

H1: Perceived Usefulness has a positive effect on Behavioral Intention.

2.3 Perceived ease of use

Additionally to perceived usefulness, "Perceived Ease of Use" has been a vital concept in many of technology adoption models, too. It is defined as "the degree to which a person believes that using a particular system would be free of effort" [20]. It has

been included as a construct in a number of studies for different types of technologies and systems, such as mobile data services in China [57], application frameworks [56], and generally new technologies [35, 62, 69, 72]. In all the above studies, the perceived ease of use of the technology concerned has a direct positive effect on the behavioral intention to use specific technology studied every time. Thus, regarding the behavioral intention to use the mobile services, it is hypothesized that:

H2: Perceived Ease of Use has a positive effect on Behavioral Intention.

In the literature studied, there is a relationship between the perceived ease of use and perceived usefulness as influential factors on consumers' behavioral intention. Researchers proposing adoption intention models verify the positive influence of perceived ease of use on perceived usefulness regarding a variety of technology topics: mobile commerce [3, 62, 72], mobile data services [57] or technology acceptance models in general [35, 56, 68, 69, 74]. Hence, it is reasonable to hypothesize that the same relationship could be included in our research regarding the mobile services:

H3: Perceived Ease of Use has a positive effect on Perceived Usefulness.

2.4 Trust

In previous studies, trust has been a significant factor in influencing consumers' behavior towards a specific technology, especially when it comes to cases of uncertain environments, such as e-commerce [6, 28, 33, 71]. It is strongly recommended that trust should also be examined as a driving factor in the area of mobile commerce [48]. Mobile commerce is exposed to greater danger of insecurity than e-commerce and therefore the importance of trust is relatively higher in m-commerce [71].

In order to define and measure trust, there have been many suggestions in literature attributing it to meanings like privacy protection permitting a user to choose how his or her personal information is used [12], or perceived credibility showing that one partner believes that the other partner has the required expertise to perform a job effectively and reliably [18, 19]. Pavlou stated that "trust in e-commerce is the belief that allows consumers to willingly become vulnerable to the online retailers after having considering the retailers' characteristics" including goodwill trust (benevolence) and credibility (honesty, reliability, and integrity) [53]. Min et al. divided the entity of trust in two sub-entities: trust in technology and trust in service providers [48]. Trust in technology redirects to technical protocols, transaction standards, regulating policies, payment systems [48], and security in mobile devices [49] whereas, according to Bhattacherjee's analysis for e-commerce services, trust in service providers refers to ability—the user's perception of provider's competencies and knowledge salient to the expected behavior, integrity—the user's perception that the service providers will adhere to a set of principles or rules of exchange acceptable to the users during and after the exchange, and benevolence—the service provider is believed to intend doing good to the users, beyond its own profit motive [12].

In this study, by trust we refer to the security in mobile payments when needed, to confidentiality of personal data (such as sending credit card details while using mobile services), to trustworthiness in the results after a mobile service is conducted and to the integrity of the terms of use of the mobile services.

Min et al. studying mobile commerce [48], Pavlou examining consumers' acceptance of electronic commerce [53], Wei et al. analyzing the m-commerce adoption in Malaysia [71], Suh and Han contributing to e-banking [60], and Gefen and Straub talking about B2C e-Services [28] detected a positive influence of trust on consumers' behavioral intention. In specific, Pavlou assumes that: "trust reduces behavioral uncertainty related to the actions of the Web retailer, giving a consumer a perception of some control over a potentially uncertain transaction [53]. On the other hand, Ha and Stoel proved that there is an influence of trust on intention to e-shop through its influence on usefulness [31]. This sense of overall control over their on-line transactions positively influences consumers' purchase intentions." Thus, it is reasonable to examine if a possible positive relationship between trust and the main constructs of the original TAM model—i.e. behavioral intention, perceived ease of use, and perceived usefulness—is valid, when it comes to the adoption of mobile commerce services. Therefore, the following hypotheses can be stated:

H4: Trust has a positive effect on Perceived Ease of Use.
H5: Trust has a positive effect on Behavioral Intention.
H6: Trust has a positive effect on Perceived Usefulness.

2.5 Innovativeness

Innovativeness in Information Technology is the "willingness of an individual to try out any new information technology" [27, 47]. In free interpretation in the field of technology acceptance, innovation refers to the degree of interest in trying a new thing, new concept, or innovative product or service [58].

Innovativeness as a personality trait has been correlated with technology adoption in previous studies as an integrated factor along with optimism, discomfort and insecurity in the framework of the Technology Readiness Index (TRI) theory [68]. Individuals, who are respected by their peers for their first-hand knowledge of an innovation, and are considered as competent technically, regard the complexity of technology less troublesome suggesting a direct positive effect on perceived ease of use [74]. Furthermore, Walczuch et al. hypothesize that innovativeness has a positive impact on perceived ease of use and perceived usefulness regarding the adoption process of IT from service employees [68]. Kuo and Yen, also, examined the relationship of innovativeness with perceived ease of use and perceived usefulness [42]. Their study showed that innovativeness influences positively the perceived ease of use of 3G mobile value-added services, whereas the influence on perceived usefulness of 3G mobile value-added services is insignificant. Lu et al. studied the influence of personal innovativeness and social influence on wireless internet services and found that they do not have a direct significant effect on users' intention to adopt the wireless internet services via their mobile devices [46]. Innovativeness has also been examined as a factor influencing the use of Internet [44]. Chen & Tong discussed the importance of innovation for the mobile telecom industry [16], as well as, Sulaiman et al. showed that personal innovativeness reflects on the adoption intention of mobile banking in Malaysia [61].

The positive results of studies around the direct effect of innovativeness on mobile commerce in Singapore [73] and on mobile shopping [3] have aroused the curiosity of

the authors to examine the effect that innovativeness has on the behavioral intention, the perceived usefulness, and the perceived ease of use of mobile services in the Greek market. Based on the above literature, the following hypotheses can be stated:

H7: Innovativeness has a positive effect on Behavioral Intention.
H8: Innovativeness has a positive effect on Perceived Usefulness.
H9: Innovativeness has a positive effect on Perceived Ease of Use.

2.6 Relationship drivers

Modern marketing indicates that relationship building between the customers and the brand is recommended to earn customers' loyalty and hence, increase the purchase interest for this brand's products. Striving towards this direction, one of the rules for a firm to build successful relationships with its customers is to have distinctive competencies [50]. Among other potential sources of such distinctive competencies, Lacey referred to customized services, which can reflect superior value or psychological benefits to the customers [43]. More precisely, his research work concluded to the fact that preferential treatment, as a variable of resource drivers, has a direct positive influence on customer's commitment to the firm, which finally leads to increased purchase intentions. Since 1988 Edvardsson studying the service quality, has pointed out the importance of adapted services to the individuals' special requirements [24]. Until today, though, individualization is a determining user requirement [14].

Experts in the marketing field have recognized some unique features of the mobile technology, which can help exclusively with the relationship building between the customers and the brand. Mobile services, mainly due to the functions of SMS and MMS exchange, have the exclusiveness of ubiquitous and universal information accessibility, of information personalization and information dissemination [48]. Mobile and wireless technology do not set information access restrictions regarding time and space [8]. Consumers can reach the information and use the applications from everywhere [52], and anytime [38, 52, 75]. This gives a strong advantage for time-sensitive and location-based content and services to be received by the consumers at the point accustomed to their personal identity [23, 32, 52, 70]. Thus, personalized information and/or services are able to be achieved.

Because of these features, the marketing experts seized the chance to exploit the mobile services as an adding channel to the existing line of channels in order to promote specific products, give new buying medium opportunities and, finally, increase consumers' intention to use these products [52]. In this study, however, we change the roles and view the mobile services as the final product. Borrowing the aforementioned marketing ideas, we make the hypothesis that the characteristics of personalization and preferential treatment that the mobile services can offer might increase their own adoption, as they do with any kind of products.

Scharl et al. examining the success factors of mobile marketing referred again to personalization as an influential factor [59]. They gave examples, such as SMS advertising campaigns that will be sent preferably to phone numbers kept into categorized databases according to the customers' previous actions; examples of such actions are past leisure activities, music interests or occupation (preferential treatment). Taking advantage of mobile services' location and time personalization people can ask for

directions to the nearest gas station open at the time of request or can receive alerts and flight delay notices through their mobile devices.

Deeper study dwelling on parameters, which lead to successful mobile services implementation, includes another significant characteristic of m-services: individuals need to decide when to respond to a mobile transaction, if at all [59]. Consumers need to have the access control [29] and freedom to give permission for their participation in mobile marketing activities [10]. And the permission needs to be dynamic; it does not only refer to the consumers' "opt-in" agreement, but also to the opportunity to change their preferences or stop their participation in the mobile transaction [9], whenever they feel to do so.

Among other factors that contribute to successful mobile advertising, Scharl et al. concluded to the fact that some common mobile applications urge the recipients to act on the spot [59]. An example of such an application is the mobile couponing. Mobile coupons are stored in the mobile phone's memory (they are hard to get lost or forgotten) and so, they are easy to redeem. If consumers are subject to get "rewarded" with mobile coupons, discount prices, prizes, newsletters, free call time, etc. when they participate in a mobile transaction, they would be motivated to use the mobile services more frequently [6].

We organize all the above mobile services usage indicators into one factor entitled Relationship Drivers. To sum up, relationship drivers is a term used in our study to declare the time and location personalization of the m-services, their adaptation to the consumers' profile, the consumers' dynamic permission option and the consumers' reward by the use of the m-services. They are teamed up in one construct, since we hypothesize that these dimensions have a common characteristic; they create a relationship between the consumers and the m-services. This relationship, finally, influences the consumers' mobile services adoption intention. Thus in our model:

H10: Relationship Drivers have a positive effect on the Behavioral Intention.

After a relationship is evolved between the consumers and the mobile services, it is reasonable to assume that the individuals might view the mobile services as an integrated part in their lives as they do with the mobile phones [36]. They are expected to be emotionally attached to the mobile services and, hence increase their actual use. Through the increased usage, people are getting used to conducting mobile transaction and, finally, find them more useful. So, we hypothesize that:

H11: Relationship Drivers have a positive effect on the Perceived Usefulness.

2.7 Functionality

Kim S. and Garrison in [39], trying to propose an extension of technology acceptance model regarding the mobile wireless technology, define as construct the "Perceived Ubiquity" as the "individual's perception regarding the extent to which mobile wireless technology provides personalized and uninterrupted connection and communications between the individual and other individuals and/or networks." Additionally, they define "Perceived Reachability" as the "the degree to which an individual reach other individuals anytime-and-anywhere" given that technology have the capability of being connected. Their findings verify the positive effect of perceived ubiquity

and perceived reachability on behavioral intention of the TAM model. Also, Dholakia et al. [22] refer to "anytime-and-anywhere" capability as a strong influential factor. Gülçin [30], refers to accessibility—i.e. everywhere and all-the-time access to mobility—as an important user requirement for mobile commerce.

The latter, also, mentions among the significant m-commerce user requirements, the need for comprehensible interface, which guides the user of the mobile application through the services' stages.

Another approach is followed by Kim, H.W. et al. and DeLone et al., which shows that "Technicality" influences the individual's "Perceived Value" of the service, which, finally, influences the adoption intention. Hence, technicality has an indirect effect on adoption intention. Technicality includes in its meaning the concepts of connectivity, as an instant and straightforward connection, and efficiency, as the quick loading and short response time. Lei-da Chen [15], also, refers to response time as a participating factor in his suggested model of consumer acceptance of mobile payments.

In the study herein, we borrow from the above literature the concepts of the service's response time, the connection speed (to the mobile internet), the comprehensive interface, and the technological infrastructure (regarding the provision of access to the services from anywhere and anytime) and introduce the construct "Functionality". We hypothesize that:

H12: Functionality has a positive effect on Perceived Usefulness.
H13: Functionality has a positive effect on Behavioral Intention.

All the hypotheses formed above, are summarized in Table 2.

3 Methodology and results

3.1 Research method

3.1.1 Operationalization of variables

Operational definitions of the study instruments are shown in Table 3. For each variable, a multiple-item scale was developed where each item was measured based on a 5-point Likert scale, ranging from 1—"Completely Disagree" to 5—"Completely Agree". Three items were used to measure relationship drivers, four items were used to measure perceived ease of use, trust, innovativeness, functionality and behavioral intention, whereas five items were used to measure perceived usefulness.

3.1.2 Data collection and sample characteristics

Data were collected through a structured questionnaire both in a hard-copy and an electronic form. The electronic version was uploaded on a website for a month, from January 15th to February 15th 2010. Additionally, contacts from various mailing-lists were asked to fill in the questionnaire, as well as members of two popular social networks—Facebook and Twitter—were encouraged to participate in the survey. The

Table 2 The definitions of the research hypotheses

Hypotheses	Description	Path
H1	Perceived Usefulness has a positive effect on Behavioral Intention.	PU → BI
H2	Perceived Ease of Use has a positive effect on Behavioral Intention.	PEOU → BI
H3	Perceived Ease of Use has a positive effect on Perceived Usefulness.	PEOU → PU
H4	Trust has a positive effect on Perceived Ease of Use.	TR → PEOU
H5	Trust has a positive effect on consumers' Behavioral Intention.	TR → BI
H6	Trust has a positive effect on Perceived Usefulness.	TR → PU
H7	Innovativeness has a positive effect on consumers' Behavioral Intention.	INN → PEOU
H8	Innovativeness has a positive effect on Perceived Usefulness.	INN → PU
H9	Innovativeness has a positive effect on Perceived Ease of Use.	INN → BI
H10	Relationship Drivers have a positive effect on the Behavioral Intention.	RD → BI
H11	Relationship Drivers have a positive effect on Perceived Usefulness.	RD → PU
H12	Functionality has a positive effect on Perceived Usefulness.	F → PU
H13	Functionality has a positive effect on Behavioral Intention.	F → BI

questionnaire was based on prior surveys approved for their validity and reliability and was pretested before being widely distributed. A pilot study using a sample of thirty responses helped to identify possible problems in terms of clarity and accuracy. Thus, comments and feedback from respondents improved the final presentation of the items. Fifty-seven participants gave incomplete answers and their results were dropped from the study. As a result, the final sample consisted of 445 consumers.

The demographic profile of respondents presented in Table 4 indicates that 51.5 % are male and 48.5 % female. The vast majority (88.1 %) is between 18–34 years old, whereas only 2.9 % is above the age of 44. In terms of their educational background, 80.4 % has received a higher education degree, whereas with respect to their occupation, about one out of four (40.1 %) are students, followed by private employees (18.9 %) and freelancers (17.6 %). Finally, 67.1 % of respondents have a monthly income up to 1,500 €, whereas about one out of five (19.1 %) do not reveal his/her income.

3.2 Data analysis and results

Structural equation modeling (SEM) using maximum likelihood estimation was used to test the hypothesized model. SEM techniques examine the covariance structure and

relationships between and among latent variables including the effects of direct, indirect, reciprocal and spurious causal relationships. SEM does not assume variables are accurately measured and includes an estimate of measurement error. A conventional model in SEM terminology consists of two components, the measurement model, representing how measured variables come together to represent constructs, and the structural model, showing how constructs are associated with each other [32]. Kline suggested a two-step model building approach to SEM [41]. In the first step, the measurement model is estimated to determine whether the intended constructs are indeed measured by the underlying latent variables. This is also known as a Confirmatory Factor Analysis (CFA) model. CFA assumes each manifest variable to be a distinct indicator of an underlying latent construct, whereby different constructs are permitted to be intercorrelated. After the constructs have met the required measurement standards, the relationships between the constructs can be estimated. This leads to the second step, where the structural model is tested to investigate the strength and direction of the relationship between the theoretical constructs. An insignificant difference between a measurement model and a structural model would generally provide supporting evidence for the proposed theoretical model. In this study, LISREL 8.8 was the software used to assess the measurement and the structural models.

3.2.1 Measurement model

The measurement model was tested using CFA, in order to assess how measured variables logically and systematically represent the constructs involved in the hypothesized model. The model included 28 items describing 7 latent constructs: behavioral intention (BI), perceived usefulness (PU), perceived ease of use (PEOU), innovativeness (INN), trust (TR), functionality (F) and relationship drivers (RD).

The model's overall goodness of fit was assessed using the following combination of common model-fit measures: χ^2/d.f., the non-normed fit index (NNFI; [64]), the comparative fit index (CFI; [11]), the adjusted goodness of fit index (AGFI), the root mean square residual (RMR) and the root mean square error of approximation (RMSEA; [13]). This choice of fit statistics was informed by Hair et al. recommendation to utilize fit indices taken from different classes (absolute fit, absolute fit with penalty clauses, and incremental or comparative fit) [32]. Table 5 lists the criterion cut-off used to judge the goodness of fit relative to the observed data. Although there is little consensus on cut-off values for adequate fit [45], conventional guidelines were followed. As shown in Table 5, the measurement model exhibited a fairly good fit with the data collected. Therefore, we could proceed to evaluate the psychometric properties of the measurement model in terms of reliability, convergent validity and discriminant validity.

The completely standardized loadings for the observed variables are presented in Table 6. The lowest loading obtained is 0.49 for F3, F4 and RD3. These three loadings estimates fall just below the 0.5 rule of thumb [32]. The unconstrained loadings are all statistically significant at the 0.05 level, having estimates that are more than twice the size of their standard errors.

The construct reliability (CR) was estimated to evaluate internal consistency of the measurement model (Table 7). Construct reliability values are all acceptable, close

Table 3 The operational definitions of the research variables

Research variables	Operational definition
Behavioral Intention (BI)	BI1: I intend to use m-services in the near future BI2: I believe my interest towards m-services will increase in the future BI3: I intend to use m-services as much as possible BI4: I recommend others to use m-services
Perceived Usefulness (PU)	PU1: I think using m-services would make it easier for me to conduct transactions PU2: I think using m-services would make it easier for me to follow up my transactions PU3: I think using m-services would increase my productivity PU4: I think using m-services would increase my effectiveness PU5: I think using m-services would increase my efficiency
Perceived Ease of Use (PEU)	PEU1: I think using m-services would be easy PEU2: I think learning to use m-services would be easy PEU3: I think finding what I want via m-services would be easy PEU4: I think becoming skillful at using m-services would be easy
Trust (TR)	TR1: I feel using m-services in monetary transactions is safe TR2: I feel my personal data are in confidence while using m-services TR3: I feel the terms of use are strictly followed while using m-services TR4: I feel using m-services for my transactions is trustworthy
Innovativeness (INN)	INN1: I am usually among the first to try m-services INN2: I am eager to learn about new technologies INN3: I am eager to try new technologies INN4: My friends and neighbours often come to me for advice about new technologies and innovation
Relationship Drivers (RD)	RD1: I think m-services are customized to my profile RD2: I think m-services are customized to the location and time I am, when I use them RD3: I think using m-services gives me the opportunity to control the start, continuation and end of my transactions
Functionality (F)	F1: I think the connection speed is high enough for me to use it F2: I think the transaction speed is high enough for me to use it F3: I think the m-service's interface is comprehensible enough for me to use it F4: I think the anywhere-anytime accessibility infrastructure is high enough for me to use it

to 0.7 or above, indicating high internal consistency of the latent constructs. The variance-extracted estimates (VES) range from 41.22 % for relationship drivers to 84.96 % for perceived usefulness. The estimates of perceived ease of use and relationship drivers do not exceed the 50 % rule of thumb suggesting inadequate, though acceptable convergence [32]. Also note that all variance-extracted estimates are greater than the corresponding interconstruct squared correlation estimates in Table 7 (below the diagonal). Therefore, this test does not suggest problems with discriminant va-

Table 4 Demographic characteristics of the respondents

Demographics		Frequency	Percent (%)
Gender	Male	229	51.5 %
	Female	216	48.5 %
Age	18–24	157	35.3 %
	25–34	235	52.8 %
	35–44	40	9.0 %
	>44	13	2.9 %
Education	Elementary school	4	0.9 %
	High school	83	18.7 %
	University/Tech. Col.	213	47.9 %
	Master/PhD	145	32.5 %
Occupation	Student	178	40.1 %
	Private Employee	84	18.9 %
	Public Servant	48	10.8 %
	Freelancer	78	17.6 %
	Unemployed	24	5.4 %
	Other	33	7.2 %
Monthly Income (€)	<600	102	22.8 %
	601–900	80	18.0 %
	901–1200	55	12.4 %
	1201–1500	62	13.9 %
	1501–1800	23	5.2 %
	1801–2400	20	4.5 %
	>2400	18	4.1 %
	I don't answer	85	19.1 %

Table 5 The model-fit indices

Fit Indices	Recommended value	Measurement model	Structural model
χ^2/d.f.	≤3.00	2.16	2.15
NNFI	≥0.90	0.97	0.97
CFI	≥0.90	0.97	0.97
GFI	≥0.90	0.90	0.90
AGFI	≥0.80	0.87	0.88
RMR	≤0.05	0.049	0.049
RMSEA	≤0.07	0.051	0.050

lidity. In addition, inspection of standardized residuals and modification indices did not suggest the inclusion of other paths that would significantly improve the fit of the model.

Table 6 Standardized factor loadings and individual item reliability

Item	Factor Loading (>0.7)	R^2 (>0.5)
PEOU1	0.75	0.56
PEOU2	0.69	0.48
PEOU3	0.63	0.4
PEOU4	0.67	0.45
PU1	0.71	0.51
PU2	0.82	0.67
PU3	0.9	0.82
PU4	0.82	0.68
PU5	0.86	0.74
TR1	0.77	0.6
TR2	0.74	0.55
TR3	0.76	0.58
TR4	0.72	0.52
INN1	0.65	0.42
INN2	0.86	0.73
INN3	0.88	0.78
INN4	0.7	0.49
F1	0.91	0.84
F2	0.93	0.86
F3	0.49	0.24
F4	0.49	0.24
RD1	0.67	0.45
RD2	0.74	0.55
RD3	0.49	0.24
BI1	0.82	0.67
BI2	0.82	0.67
BI3	0.9	0.81
BI4	0.78	0.61

Table 7 Reliability, variance extracted estimates and discriminant validity

	CR	VES	1	2	3	4	5	6	7
PEOU	0.78	0.47	1.00						
PU	0.91	0.85	0.17	1.00					
TR	0.84	0.56	0.10	0.29	1.00				
INN	0.86	0.60	0.12	0.18	0.15	1.00			
F	0.81	0.54	0.05	0.00	0.01	0.01	1.00		
RD	0.68	0.41	0.18	0.07	0.10	0.05	0.13	1.00	
BI	0.9	0.69	0.12	0.28	0.18	0.29	0.00	0.13	1.00

3.2.2 Structural model

Once the measurement model was correctly specified, a structural model was estimated to provide an empirical measure of the hypothesized relationships among the research variables and constructs. A similar set of goodness-of-fit indices was used to examine the structural model. Comparison of all the fit indices with their corresponding recommended values provided evidence of a good model fit (Table 5). The model provided similar parameter estimates and similar overall model fit to the CFA model (χ^2/d.f. = 2.15, RMSEA = 0.050, RMR = 0.049, CFI = 0.97). An inferential test for close fit (defined as RMSEA < 0.05) was also employed, with a nonsignificant result ($p > 0.05$) suggesting good model fit [13]. All indices suggest that the hypothesized structural model fits the data reasonably well.

The path coefficients and loading estimates of the structural model were examined so as to make sure they have not changed substantially from the measurement model. The loading estimates are virtually unchanged from the CFA results. Only two estimated completely standardized loadings have changed and the maximum change was 0.03 (RD3). This indicates parameter stability among the measured items and further supports the hypothesized model's validity.

Figure 2 shows the path diagram with the resulting completely standardized structural parameter estimates included on the paths. The estimation of the structural model indicates that all but three hypotheses were supported (Table 8). The exceptions are the effects of perceived ease of use, trust and functionality on behavioral intention (H2; $\gamma = 0.02$, $t = 0.37$, $p > 0.05$, H5; $\gamma = 0.06$, $t = 1.11$, $p > 0.05$ and H13; $\gamma = -0.04$, $t = -0.76$, $p > 0.05$). It is important to note that perceived ease of use does not have a direct effect on behavioral intention. However, this variable has a positive indirect effect on behavioral intention through perceived usefulness (H3; $\beta = 0.21$, $t = 3.97$, $p < 0.01$). As predicted, trust exerts a strong positive effect on perceived usefulness (H6; $\gamma = 0.39$, $t = 7.11$, $p < 0.01$) and has a marginal impact on perceived ease of use (H4; $\gamma = 0.12$, $t = 1.99$, $p < 0.05$). The effects of innovativeness on perceived ease of use, perceived usefulness and behavioral intention are also positive and significant (H7; $\gamma = 0.25$, $t = 4.15$, $p < 0.01$, H8; $\gamma = 0.20$, $t = 4.00$, $p < 0.01$, H9; $\gamma = 0.33$, $t = 6.20$, $p < 0.01$). Relationship drivers contribute positively to both behavioral intention and perceived ease of use (H10; $\gamma = 0.18$, $t = 3.04$, $p < 0.01$, H11; $\gamma = 0.28$, $t = 4.00$, $p < 0.01$). Functionality has also a positive impact on perceived ease of use (H12; $\gamma = 0.13$, $t = 2.22$, $p < 0.05$), which is in line with the corresponding theoretical assumption. Overall, given that ten of the thirteen estimates are consistent with the hypotheses, the results support the theoretical model with a caveat of the three paths that are not supported.

As a further test, the difference in fit between the SEM and CFA χ^2 values was examined. The resulting $\Delta\chi^2$ is 0.34 with 1 degree of freedom ($p = 0.44 > 0.05$). Therefore, there is no significant difference between the two models. This implies that the SEM model explains the data equally well compared to the CFA model and is preferred.

Table 8 Path coefficients and t-values of hypotheses

Hypotheses	Path	Coefficient	t-value
H1	PU → BI	0.30	5.16
H2	PEOU → BI	0.02	0.37 ns
H3	PEOU → PU	0.21	3.97
H4	TR → PEOU	0.12	1.99
H5	TR → BI	0.06	1.11 ns
H6	TR → PU	0.39	7.11
H7	INN → PEOU	0.25	4.15
H8	INN → PU	0.20	4.00
H9	INN → BI	0.33	6.20
H10	RD → BI	0.18	3.04
H11	RD → PU	0.28	4.00
H12	F → PU	0.13	2.22
H13	F → BI	−0.04	−0.76 ns

4 Discussion and implications

The present study examines how behavioral intention, perceived usefulness of m-services, the perceived ease of their use, innovativeness, trust, relationship drivers, and functionality co-exist in the same model predicting consumer behavioral intention to use mobile services. The findings of the study offer strong evidence in support of the proposed research model. The results have important implications for practitioners, especially application developers, services content providers, mobile services manufacturers and scholars, who are keen on studying technology acceptance models and mobile services usage. The theoretical and managerial implications are described below.

4.1 Theoretical implications

This work, based on recent literature, tests possible influences of the aforementioned constructs on behavioral intention, as well as possible influential relationships between them. The results of this study suggest an enriched acceptance model of mobile services.

In the proposed model not all of the initial hypotheses are verified. Perceived ease of use does not seem to have a strong effect on behavioral intention. This complies with the pre-implementation TAM models as suggested by [69]. Davis separated his original suggestion of the TAM model in two versions based on users' experience. In particular, he proposed the pre-implementation and the post-implementation TAM models; that are behavioral intention's examination before or after the users' try the technology respectively. According to the former, the model predicts technology acceptance based on the perception of usefulness and ease of use, whereas in the latter, perceived usefulness affects behavioral intention unlikely to the perceived ease of use. On the other hand, perceived ease of use has an indirect effect on behavioral intention through perceived usefulness as indicated in all of the studied literature presented in the second section.

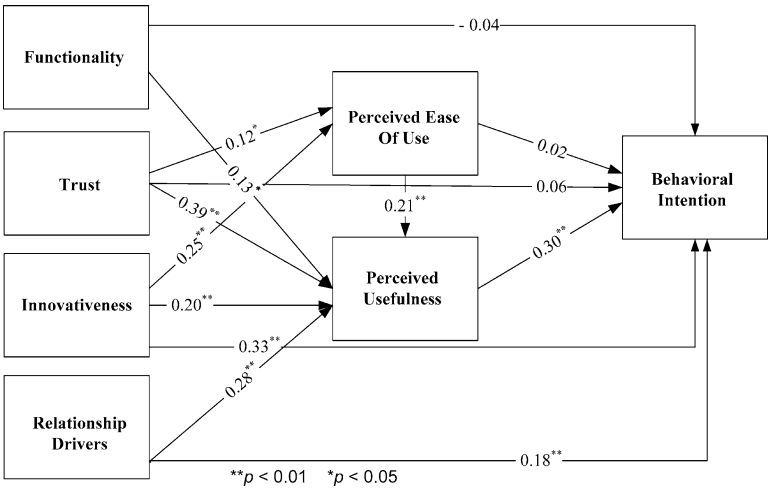

Fig. 2 SEM Results for the proposed model

The role of functionality is not as influential on behavioral intention as it was initially hypothesized. However, this could be explained. In [15], regarding m-payments, it was found that perceived transaction speed does not have a direct effect on m-payment adoption intention. It seems that network coverage, transaction speed, response time and a user friendly interface are likely to influence user's perception regarding the ease of use of the services rather than directly their adoption intention. This is reasonable, since a comprehensible interface, for example, reduces the time and effort needed to learn how to use a new service, and actually the use of the service itself.

Furthermore, trust's role is noteworthy to be mentioned. The hypothesis that trust has a positive effect on behavioral intention is rejected. It seems that the respondents' adoption intention is not directly influenced by safety and security drivers. These items, however, have a very strong effect on perceived usefulness (which, in turn, affects their behavioral intention). The relationship between trust and perceived usefulness is the strongest in the model. This theoretical conclusion indicates that the services are perceived as useful as long as they are trustworthy.

It is concluded, as it is undoubtedly expected after intense and deep study of the TAM models, that behavioral intention is affected by perceived usefulness, innovativeness and relationship drivers. Individual's innovativeness has the strongest effect among these three factors. This shows that people might primarily need to be motivated and intrigued by their own nature in order to adopt these new technologies.

The verification of the relationship drivers' hypotheses is a significant contribution to the TAM literature. It is a concept borrowed from the marketing field; so, its implementation in a survey regarding technology services suggests a new perspective. It is a verification indicating that mobile services, just like all other products, need also a marketing prediction approach in order to get successfully adopted. Finally, it is of great significance to mention that personalized services and the optional partic-

ipation in/or withdrawal from the services' procedure have a strong effect on user's perception regarding the services' ease of use.

4.2 Managerial implications

This survey's conclusions can help practitioners evaluate their development decisions based on the emphasis they place on the different factors which influence the acceptance and adoption of mobile services. Companies and organizations involved in the mobile services development, mobile commerce investment and mobile marketing could use them as a consultancy tool while organizing their work and implementing their business ideas.

Mobile device manufacturers, for example, should take into account the important role of functionality onto perceived ease of use. It seems that consumers need comprehensible interfaces, which can adequately guide them and provide analytical instructions throughout the transaction process. Additionally, the same implication holds for wireless network providers. Having ubiquitous access to the mobile services would encourage their usage. Uncertainty in its accessibility, as well as low transaction speed, would lead to unreliable services.

Moreover, trust increase should be given priority. Mobile content providers, mobile application developers and systems security software providers should be in cooperation. Security in monetary transactions, data integrity and confidentiality are the first to standardize a mobile service as useful.

Last but not least, it should be mentioned that mobile services firms or governmental organizations that provide mobile functions should take advantage of the relationship ties that m-services are able to create with their users. This is accomplished through personalized services, which are optional and can be reached anytime at any place. For example, airline companies trying to avoid the long check-in queues at the airports and the informational help-desks could motivate travelers to use mobile check-in, or notify them for possible delays and alternative flight solutions.

4.3 Limitations and future work

Despite the fact that the aforementioned results provide meaningful implications, the research can be further improved by overtaking some important limitations. It would be of high interest, to investigate the behavior of the model after the addition of other constructs suggested by the literature, such as cost. Transaction, subscription and equipment costs might have a negative influence on behavioral intention regarding mobile services adoption and affect the relationships between existing factors.

Additionally, it is to be emphasized that these findings are limited to a sample of Greek consumers. Similar studies could be conducted in other countries, taking into consideration the different cultural notions in order to get comparative data for a cross-cultural study or a meta-analysis of existing studies. Such a comparison could be beneficial for the mobile industry targeting to multicultural services and global utilities. On the other hand, considering a larger sample size from the same population could give a more representative and accurate view of the mobile services penetration, and increase the external validity of the study.

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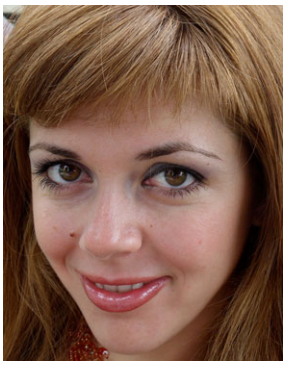

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