

Application Type and Usage Experience as Drivers to Multi-Technology Acceptance: An Empirical Study in Mobile Internet Services in Indonesia

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Abstract

In the information communication technology (ICT) services, one critical aspects of any consumers' services success depends largely on the consumers' adoption to newly introduced technology, which relates directly to consumers' demand to such services. Consumers' adoption to multi technology is increasingly popular with the advancement of ICT. Series of consumers' adoption of technology research models and theories, such as technology acceptance model (TAM) and theory of planned behavior (TPB), have significantly contributed to the understanding of how complex the consumers' behaviors are. Those research, however, are limited on the adoption of single, independent, and unchanging technology.

The advancement of ICT has enabled Mobile Service Providers (MSPs) in Indonesia to provide high quality and ubiquitous mobile Internet services. Such services have been progressing rapidly in such that during the same time frame, overlay of several technologies exists: Fixed/wireless Internet and mobile Internet; allowing consumer to choose multi-technology that are contextually best fit to the need. The increase of ICT sophistication and its supplies into the market allows multiple services offering that are competing and complementing each other, further increase the uncertainty of the consumers' adoption and diffusion to mobile Internet technology. Similar and/or identical applications can be accessed from different types of technology. Research model were developed and several hypothesis were proposed.

The objects of the research were the Internet and mobile users in big cities in Indonesia that were randomly sampled. Structural Equation Modeling (SEM) was constructed to verify the model. Our research finds that consumers' are accustomed to use similar and/or identical applications on more than one technology. Some key applications, such as email, on line chatting, and on line networking were found to be the link of multi technology adoptions.

The usage experiences and the network effects determine consumers' choice of technology. We also found that consumers' previous experience in ICT positively correlate to multi-technology adoptions. Positive price and device attractiveness differential (the previous versus the later technology) promotes single adoption toward later generation of mobile Internet technology. However, negative price and device attractiveness differential promotes the adoption toward multi-technology.

Our finding will be very useful for technology supplier and service provider's strategy's on how to introduce new technology in such that the older technology do not create barrier for the adoption and instead MSP can find smoother migration by finding the co-adoption path at any given time that can accelerate the return on investment of the overall technology. In particular, we are grateful to propose a slightly different perspective to TAM.

Key words: Internet, ICT, Mobile Internet, TAM, TPB, TAMM, multi-technology.

Introduction

In the current era of new economy, information communication technology (ICT) has shown its important role for business performance and economic growth in many countries [1][2]. The ICT revolution was marked by the convergence of elements of technology into a single technological interface namely internet-protocols or "IP" [3]ⁱ. IP has created bridge facilitating economics solution for compatibility and interoperability across the diverse networks [4], and become the de facto standard offering for three new layers of servicesⁱⁱ.

The advancements in ICT have enabled mobile service providers (MSPs) to provide high quality, diversified, and personalized services for and develop long-term individualized relationships with customers [5][6]. Mobile cellular technology has been progressing rapidly [7], in which recently marked by the surge of the third generation (3G) of mobile Internet servicesⁱⁱⁱ creating multi-generation of technology to exists in the same time frame [3].

Consumer demand on ICT has also been evolving and has long known for its ambiguous adoption to new services^{iv}. With the increase of technology push, consumers are faced with multiple choices of services that are competing and complementing each other [3][7][8]. Under network economy, however, consumers are more empowered [10]. Adoption of multi-technologies by end users has been an increasing trend in the market, and become the market force in ICT industry^v. With the maturity and convergence of technology in an increasing speed, competing technology can offer similar but not identical in technical performance with different set of experience perceived by users and influenced by the creation of value network [9].

As this study investigates the factors influencing customers' attitude toward multi-technology use, it will explore the approach of technology acceptance model. Series of consumers' adoption of technology research models and theories, such as technology acceptance model (TAM) and theory of planned behavior (TPB), have significantly contributed to the understanding of how complex the consumers' behaviors are. Existing research put emphasize more on consumer technologies [11] [12] but are limited on the

adoption of single, independent, and unchanging technology [13]. Multi technology acceptance is important trend that need to be understood in the context of service innovation in order to more accurately predict the voluntary technology acceptance by users [14] [15]. Knowledge on multi technology acceptance is increasingly important for service providers to anticipate disruptive nature of such technology [16][17]. Disruptive technology will displace the older technology while complementing technology allows the co-existence between the older and newer technology, promoting multi technology acceptance [18]. We propose to update TAM for the case of multi-technology environment.

ICT convergence contributes to compatibility and interoperability that allows the use of the same or similar applications over multi-generations of technology. Users use applications to perform similar or the same task over ranges of technology that gives them different set of users' experience and its decision to adopt is influenced by mobile social network [5] [19] [20]. Certain kind situation gives certain kind of users' experiences, which were contributed by: (1) user's experience paradox, (2) co-creation experience, and (3) network effects of expectation, coordination, and compatibility [21] [22]. We developed model incorporating application type and user experience as the external factor influencing the multi-technology perceived usefulness and ease of use. Social and professional networks are the external factors to the subjective norm of the multi-technology acceptance. Relative price and device attractiveness are the moderating factors of the behavioral intention to the actual multi-technology use.

The model is verified through the research conducted to the Internet and mobile users in big cities in Indonesia that were randomly sampled. Results were then analyzed using the Structural Equation Modeling (SEM) to verify the proposed model. We find that consumers' are accustomed to use similar and/or identical applications on more than one technology. Some key applications, such as email, on line chatting, and on line networking were found to be the link of multi-technology adoptions. Users prefer to use laptop (wireless portable Internet technology) to use application such as email under certain situation and prefer to use mobile device (3G technology) to also access email under different kind of situation.

Model and Hypothesis

In forming the research model and hypothesis, we review the existing theory in the context of the discussion. Winning the consumers requires accurate understanding on consumers' technology acceptance behavior. Foundation of predicting consumers' behavior intention is by the theory of reasoned action (TRA) [23] [24] [25] that was then extended into theory of planned behavior (TPB) [26] [27] and technology acceptance model (TAM) [23] [28].

Theory of Reasoned Action (TRA)

TRA says that consumers consciously decide on performing or not performing specific behavior after evaluating various criteria concerning the behavior before actually performing it. Behavioral intention is a measure of the strength of one's intention to perform a specified behavior and actual behavior is an individual's feeling about performing the target behavior [24]. The behavioral intention is postulated to be a function of the individual's attitude toward

the act and the subjective norm. Whether the attitude toward the act or the subjective norm exerts a greater influence on the behavioral intention depends on the individual and the decision object [24]. The subjective norm is a result of the individual normative belief, which is an individual's assumption about what other person wants her to do, and his motivation to comply with the expectations in this person. In addition, Lee and Green [25] found that the theory of reasoned action performs well in explaining behavioral intentions among consumers in western and Asia's cultures.

Theory of Planned Behavior (TPB)

TPB is a well-established general theory of social psychology, which affirms that specific salient beliefs influence behavioral intentions and subsequent behavior [26] [27]. In TPB, individual behavior is driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior, the subjective norms surrounding the performance of the behavior, and the individual's perception of the ease with which the behavior can be performed (behavioral control) [26] [28].

The TPB extends the TRA to account for conditions where consumers do not have full control over the situation [24] [28]. Three antecedent constructs are attitude, subjective norm, and perceived behavioral control in the TPB. Attitude is determined through an assessment of one's belief regarding the consequences arising from a behavior and an evaluation of the desirability of these consequences [29]. The subjective norm can be expressed as the sum of the individual perception multiplied by the motivation assessments for all relevant referents [29]. Behavioral control is one's perception of the difficulty of performing a behavior in the model [29]. Moreover, these antecedents of behavioral intention influence each other.

Technology Acceptance Model (TAM)

TRA is the foundation to the technology acceptance model (TAM) [23] [28] and has been extended into a more mature model [11] [23]. Existing research put emphasize more on consumer technologies rather than on firm's environment technology acceptance [11] [12]. TAM posits that technology acceptance is determined by user's perception of usefulness and ease of use of the technology, forming behavior intention toward the actual use [23].

TAM suggests that two beliefs, perceived usefulness and perceived ease of use, affect consumers' computer acceptance behaviors (Figure 1). A person's acceptance of a technology is to be determined by her voluntary intentions towards using the technology. The intention, is determined by the person's attitude towards the use of the technology and her perception of its usefulness. Attitudes are formed from the beliefs a person holds about the use of the technology.

The first belief, Perceived Usefulness or PU, is the user's subjective perception that using technology will be useful and using a specific application system will increase his or her job performance within an organizational context [23]. PU is an effect on the technology adoption when consumers realize the usefulness of the technology. Initially defined in the context of one's job performance, PU was later used for any common task in non-organizational settings, e.g. Internet shopping.

Perceived Ease of Use or PEOU, the second belief, is the degree to which the user expects the target system to be free of efforts [23]. The easier a system is to interact with, the greater should be for consumer's sense of efficacy and personal control [23] [31] regarding the consumer's ability to operate the technology [23]. In other words, the more consumers PEOU, the higher the intention to adopt the technology.

Figure 1: The Original Technology Acceptance Model [23]

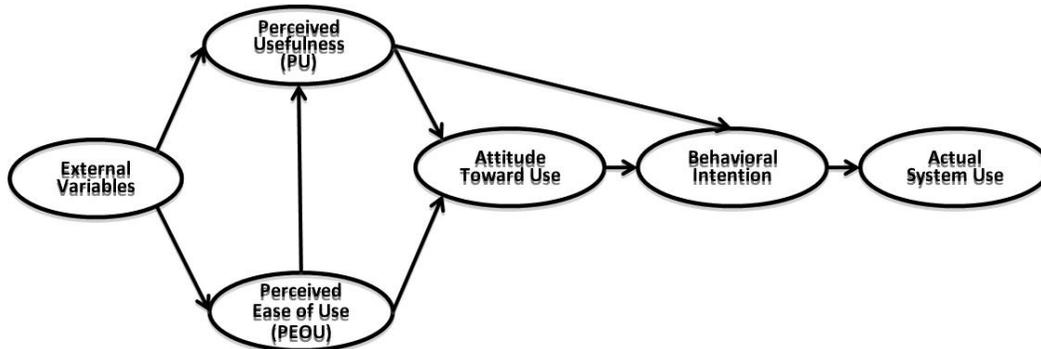


Figure 1: The Original Technology Acceptance Model [23]

External variables are referred to as system design characteristics, user characteristics, task characteristics, and nature of the development or implementation process [23].

PU is influenced by PEOU. The strength of such belief-attitude-intention-behavior relationship in predicting actual behavior largely depends on the degree of measurement specificity conducted in a research [32].

Originally developed to test the acceptance of word processor technology [23], TAM has since been extended to the acceptance e-mail, voice mail, graphics [33], DBMS [34], GSS [35], personal computer [36], WWW [37], and telemedicine technology [38], among other applications of IT and cellular technology [30]. Under the mode integrative study, the attitude belief is consider vague and being omitted in subsequent TAM's researches [11] [12].

The popularity of the TAM is broadly attributable to three factors [39]: (1) it is parsimonious, IT-specific, and is designed to provide an adequate explanation and prediction of a diverse user population's acceptance of a wide range of systems and technologies within varying organizational and cultural contexts and expertise levels; (2) it has a strong theoretical base and a well researched and validated inventory of psychometric measurement scales, making its use operationally appealing; and (3) it has accumulated strong empirical support for its overall explanatory power and has emerged as a pre-eminent model of users acceptance of technology.

Despite of its popularity, however, TAM tends to assume and treat technologies to be singular, independent, and unchanging, which is considered to be one of the most serious limitations of TAM [30]. It assumes that every situation is treated as one specific technology available for potential users. This does not reflect the actual situation of convergence of information technology industries giving opportunity for multiple-choice situation comprising various alternative technologies [16]. The main problem with the TAM simplification is that when researchers or practitioners are in reality exposed to multiple-choice situation, it may disregard a lot of available and important information in the setting. Therefore, in certain situation, where the users can choose among several alternative technologies it should be more appropriate to apply TAM in accordance with a multiple-choice reality [16]. Hence, TAM must be updated when multi technology condition exists.

Toward Multi-Technology Acceptance Model (TAMM)

We seek to investigate the underlying factors that drive users to accept particular multi-technology. We observe the followings: (1) consumers use fixed and mobile Internet technology to perform similar task, utilizing the same or similar applications, such as email, on line chatting, on line networking, and so on as application across technology become available [30]. Table 1 summarizes applications over fixed and mobile Internet technology; (2) under the same time frame and certain conditions, consumers prefer to use fixed Internet technology to mobile Internet technology. However, under other kind of conditions, consumers prefer the other way around driven by users' experience [5]; (3) consumers' are adopting more than one type of mobile technology to maintain their social and professional networks [22].

Table 1: Available Applications Across Multi-Technology

Applications	Fixed Internet Technology	Mobile Internet Technology
Voice (Circuit)	POTs VoIP	Mobile Phone
Voice Over IP (VoIP)	Skype ICQ	Skype ICQ
Short Messaging	- Online Chatting	SMS Online Chatting
Picture Messaging	Various	MMS
Information Navigation, Exploration, and Service	Explorer / Mozilla / Safari	Blackberry Nokia Internet
Email	Outlook / Webmail	Blackberry Mail Nokia PushMail
Online Chatting	YM! Skype Google Talk	YM! Skype Google Talk
Online Networking	Facebook Twitter MySpace	Facebook Twitter MySpace

Building upon single technology case, we propose a modified version of TAM for the case of multi-technology case. Referring to TAM, analogous to behavior intention in single

technology acceptance, it should be a situation where consumers' behavior intention is formed toward the use of multi-technology (BIM). In which, we propose that behavior intention of multi-technology is determined by the users' perceived of usefulness of multi-technology (PUM) and users' perceived ease of use of multi-technology (PEOUM). External factor to PUM and PEOUM is proposed, i.e. applications, and subjective norm of multi-technology (SNM) is also proposed with external variables of social and professional networks (SNM and PNM respectively). Our research model is shown in Figure 2.

Figure 2: The Proposed Multi Technology Acceptance Model (TAMM)

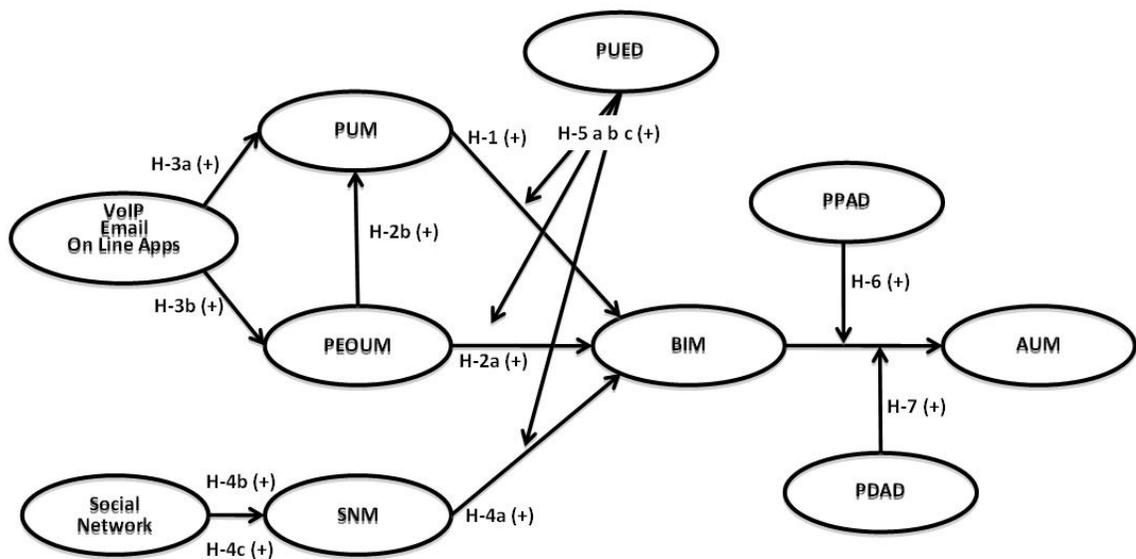


Figure 2: The Proposed Multi Technology Technology Acceptance Model [TAMM]

Legends:

- AUM: Actual Use of Multi-Technology
- BIM: Behavior Intention of Multi-Technology
- PEOUM: Perceived Ease of Use of Multi-Technology
- PDAD: Perceived Device Attractiveness Differential
- PPAD: Perceived Price Attractiveness Differential
- PUM: Perceived Usefulness of Multi-Technology
- PUED: Perceived Users' Experience Differential
- SNM: Subjective Norm of Multi-Technology

Therefore we define that users' subjective perception that using multi-technology will be useful, using more than one technology will increase his job and personal productivity, is the perceived usefulness of multi technology or PUM. In this we propose:

H-1: The users' perceived usefulness of multi-technology positively influences the behavior intention toward multi-technology use.

Similarly, user's expectation on the degree to which users expect the multi-technology target system will be free of effort is the perceived ease of use of multi-technology or PEOUM. Building upon TAM, for the purpose of development of TAMM, PEOUM will be logical analogous as the antecedent of BIM. During the early phase of new technology acceptance, PEOUM will be more significant to the formation of BIM, because of the learning phases. However, over time, PEOUM will be less significant factor to BIM and will be more significant toward PUM only. In this we propose:

H-2a: During the early phase of new technology acceptance, the users' perceived ease of use of multi-technology positively influences the behavior intention toward multi-technology use.

H-2b: The users' perceived ease of use of multi-technology positively influences users' perceived usefulness of multi-technology.

The presence of applications across multi-technology promotes positive perception of usefulness and ease of use of the multi-technology acceptance as users become more familiar to the same or similar applications under different type of technology. For example, users are expected to have positive perception that email application on mobile Internet will be both useful and easy to use, since she already familiar to email application on her PC. Therefore, types of applications that are available across multi-technology are the external variables toward the PUM and PEOUM. In this we propose:

H-3a: Multi-technology applications positively influence the users' perceived usefulness of multi-technology.

H-3b: Multi-technology applications positively influence the users' users' perceived ease of use of multi-technology.

Subjective norm can be resulted from users' social network influence to the development of the users' normative belief. In this case, we define multi-technology subjective norm (SNM) as users' assumption that other person within her social and professional network wants her to also use multi-technology, and she will be motivated to comply with their expectation [24]. Users' social network will be differentiated at least into three groups: one group that uses fixed Internet technology only, second group that uses mobile Internet technology for the same type of applications, and third group that uses mobile fixed and Internet technology for the same type of applications. In this we propose:

H-4a: The multi technology subjective norm positively influences the behavior intention toward multi-technology use.

H-4b: The users' social network positively influences the multi technology subjective norm.

H-4c: The users' professional network positively influences the multi technology subjective norm.

Different technology offers different set of users' experience in the forms of dependence on location, urgency, and time, and their interactions [40]. Mobile Internet technology offers less dependent of location compared with fixed Internet technology [5] [30] [40]. While fixed Internet technology offers more value of time when required to use a more elaborate task such as email with large attachment or on line collaborations tasks [5] [40]. Users' experience paradox also influences the preferential use of fixed Internet over the mobile Internet under a certain situation, and vice versa [21] [41]. The nature of mobile Internet allows positive users' experience on one situation but at the same time offers negative users' experience in another situation (Table 2).

Table 2: Mobile & Internet Technology Paradox [21]

Mobile Internet Paradox	Description
Empowerment / Enslavement	Always On nature of mobile Internet technology empower consumers to use the technology / Consumers' would rather not to use mobile Internet because the feeling of pressure of being connected.
Independence / Dependence	Mobile Internet device is so powerful that gives independence to consumers from space and time / Consumers' dependency to the mobile Internet increases.
Fulfills Needs / Creates Needs	The need for mobility and connectivity is satisfied by mobile Internet / New many intricate needs are created (charger, security, etc)
Competence / Incompetence	Ability to do many more things offered by mobile Internet created new sets of competence to consumers / New set of competence soon to realize that there is higher level of incompetence on many features offered.
Planning / Improvising	Mobile Internet can be as effective planning tools / Allows less time to spend on planning and rely more on technology to make up their lacking.
Engaging / Disengaging	Engaging in mobile Internet at the same time disengage to other activities.
Public / Private	Mobile technology become private and personalized communications tolls that often have to be conducted in the public area.
Illusion / Disillusion	Newer technology creates expectation to users that soon finds out that some features offered are the crude approximation of the perceived

	promised.
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When positive users' experience experienced by users, mobile Internet become the preferred technology at that time. However, under the same application when negative users' experience experienced by users, the mobile Internet become the less preferred technology, and fixed Internet technology become the more preferred technology at that time. The ability of one technology to fulfill one set of users' experience and other technology to fulfill another set of users' experience is defined as the users' experience differential. Due to complexity of the users' experience paradox and the limitation of each technology to satisfy the conflicting users' requirements, the acceptance of multi-technology will be expected to occur over prolonged period of time. Perceived users' experience differential (PUED) is defined as the perception of users on the ability of one technology to fulfill one set of users' experience and other technology to fulfill another set of users' experience. In this we propose:

H-5a: Perceived users' experience differential positively moderates the multi-technology perceived usefulness to the behavior intention toward multi-technology use.

H-5b: Perceived users' experience differential positively moderates the multi-technology perceived ease of use to the behavior intention toward multi-technology use.

H-5c: Perceived users' experience differential positively moderates the multi-technology subjective norm to the behavior intention toward multi-technology use.

Consumers' decision of buying in the ICT market is influenced by price attractiveness [42] and MSPs may use it during the predatory phase and recoupment phase knowing the advantage of network effect [43]. During the predatory phase, MSPs would allure consumers' to adopt mobile Internet technology by offering higher performance at lower price [43]. However, since the advancement of ICT significantly reduces users' switching cost [1] [2], with weaker network effect, predatory pricing may effect only temporary or limited adoption [43]. Users' expected to migrate to mobile Internet technology based on price attractiveness [42]. In respond to price predatory move by MSPs, operators would lowered the fixed Internet technology price to maintain its price attractiveness differential. Perceived price attractiveness differential (PPAD) is defined as the perceived price differences between fixed and mobile Internet technology in such that the use of multi-technology remains attractive from consumers' perspective. When there is behavior intention toward the use of multi-technology, and there exists attractive price differential, users would continue to use multi-technology. Therefore, we propose that perceived attractive price differential as the moderating factor of the actual use of multi-technology (AUM).

H-6: Perceived price attractiveness differential positively moderates the multi-technology behavior intention to the actual multi-technology.

Device availability is key to the adoption of new ICT technology [44], without device availability, consumers' ability to use the ICT service will be limited or impossible at all. Devices must have proper user interfaces, look and feel, to provide acceptable usability by users [44]. Further, device not only functionally require to access services offered by mobile Internet technology (such as managing the volume of communication), but also has become part of symbolic-interactionism (such as physical aspect of portability, ethical-personal dimension, self-image, and so on) [45] [46]. In such, device with new technology capability must have relative attractiveness to users in order for them to adopt [44] [45] [46]. Device for new technology deployment, typically is introduced not in the most mature stage in order to meet time to market constraint. So, although not in the most mature stage, due to its innovative effect, innovation and early adopters uses such devices in addition to the previous technology's devices [47].

Device attractiveness differential will influence the multi-technology use. Therefore, we define perceived device attractiveness differential (PDAD) as the perceived price differences between fixed and mobile Internet technology in such that the use of multi-technology remains attractive from consumers' perspective. When there is behavior intention toward the use of multi-technology, and there exists device attractiveness differential, users would continue to use multi-technology. Therefore, we propose that perceived device attractiveness differential as the moderating factor toward the actual use of multi-technology (AUM).

- H-7: Perceived device attractiveness differential positively moderates the multi-technology behavior intention toward the actual multi-technology use.

Research Methods

Our study examines the relationship of external variables (common applications of fixed and mobile Internet applications, such as email, on line messaging, and others), and its antecedent factors toward behavior intention of multi-technology use. We also examine the moderating role of perceived device and price attractiveness differential toward the actual use of multi-technology.

Measuring the PUM and PEOUM is based on revised analogous of perceived usefulness (PU) and perceived ease of use (PEU) under single technology as proposed by Davis [23]. Measuring the subjective norm is based on The instruments were pre-tested on samples of university students.

Questioners were then distributed randomly to the Internet and mobile users in various large cities in Indonesia. Questioners were divided into two forms: the investigation on the behavior intention on multi-technology and the actual use of multi-technology. Respondents came from various levels of education, age, genders, and occupation that have been using Internet services in the form of fixed or mobile Internet. Based on the survey, the Structural Equation Modeling (SEM) was constructed to verify the model.

Conclusions

We find that consumers' are accustomed to use similar and/or identical applications on

more than one technology. Key applications: email, on line chatting, and on line networking are significantly linked to multi-technology adoption. Perceived users' experiences differential do moderate the perceived usefulness and ease of use, and the subjective norm toward the formation of behavior intention. Price and device attractiveness differential do moderate behavior intention toward the actual use of multi-technology. We also found that consumers' previous experience in ICT positively correlate to multi-technology adoptions. Negative price and device attractiveness differential on mobile Internet promotes multi adoptions of Internet technology.

Research Implications

On practical side, technology supplier and MSPs can take major benefit from our finding. The fact that the link for multi-technology use is underlined by common applications, future introduction of newer technology can be positioned in such that existing applications can be exploited as the vehicle to expedite newer technology migration. When the newer technology is not yet at the mature stage, the applications still can be used to maintain the multi-technology adoption. Price attractiveness can be positioned in such that multi-adoption is to occur and vice versa. This finding will be very useful for technology supplier and MSPs' strategy's on how to introduce new technology in such that the older technology do not create barrier for the adoption and instead to find smoother migration by finding the co-adoption path at any given time that can accelerate the return on investment of the overall technology.

On the theoretical side, in particular, we are grateful to propose an introductory idea of TAMM (Multi-Technology Acceptance Model), a slightly different perspective to TAM.

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Footnotes

ⁱ The full protocol is actually called transfer control protocol / internetworking protocol (TCP/IP) but normally called internet-protocol (IP) in short. The growth of ICT is very much underlined by IP and packet switching invention. IP platform is a platform that provides common interfaces to various ICT layers allowing a unified interface. Unified interface allows the emergence of economic of scale, flexible internetworking, modularizations, scalable deployment, and extreme cost reduction.

ⁱⁱ The introduction of IP added three more additional layers (connectivity, middleware and applications layers), from original telecoms layers (physical/equipment, network, and consumer layers). The additional layers opens up more specialized companies to provide solutions which were not part of the original telecoms equipment company's competence [3]

ⁱⁱⁱ Is defined as an assortment of ICT services that can be accessed using a mobile device over a wide range of geographic area [8]. Consumers can not only enjoy superior services such as video streaming and mobile business solutions, but also personalize their mobile devices by various ringtones and logo.

^{iv} Various examples can be drawn that the trajectory of technology development as the push factor is only partial to the equation of the consumer adoption, the pull-factor. These examples ranges from short message services (SMS), multi-media messaging services (MMS), videophone, to video streaming services.

^v Users adopting ADSL technology are found to also largely adopt HSDPA, but abandon the dial-up connection. Users adopting 2G GSM also found to adopt fixed wireless CDMA (Flexy or StarOne) or mobile CDMA (Fren), which are the competing technologies.

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