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Toward the Development of a Revised Technology Acceptance Model

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ABSTRACT

This study develops and proposes an extended technology adoption model based on the vast literature. The proposed revised technology adoption model is a five-layer evaluation model that can be used to determine the variables that influence individuals' and organizations' embrace of new technologies. The existing technology acceptance model (TAM) and its modifications (TAM2 and TAM3) have been applied for decades in varied disciplines, including marketing and information systems, to better predict generic human perceptions, behaviors, and attitudes toward new and existing technologies. The revised TAM is less generic and includes variables pertaining to culture-tech (indigenization) that predict user behaviors and intentions to adopt new technology. This proposed TAM offers the potential to engineer destruction in the development of culture-tech or indigenous technology by allowing local customization of technological contents and features to meet the needs of individuals and organizations, especially those in developing and emerging countries. The revised TAM, if supported empirically, will guide researchers and developers to capitalize on technology innovation rooted in users' indigenous and personal attributes and characteristics.

Keywords: Technology, new technology, culture-tech, developing countries, emerging countries, innovation, revised TAM.

INTRODUCTION

Since the early 1990s, various innovative changes and developments in the information, communication, and mobile technology field have disrupted traditional business models in many countries, transformed consumer behaviors, and created a new segment of consumers popularly known as tech-savvy or digital natives. In consumer behaviors, the adoption, acceptance, and use of different technologies, applications, and systems in everyday life have been attributed to several factors, including the proliferation of smart and portable devices, social media, and easy, frequent access to information.

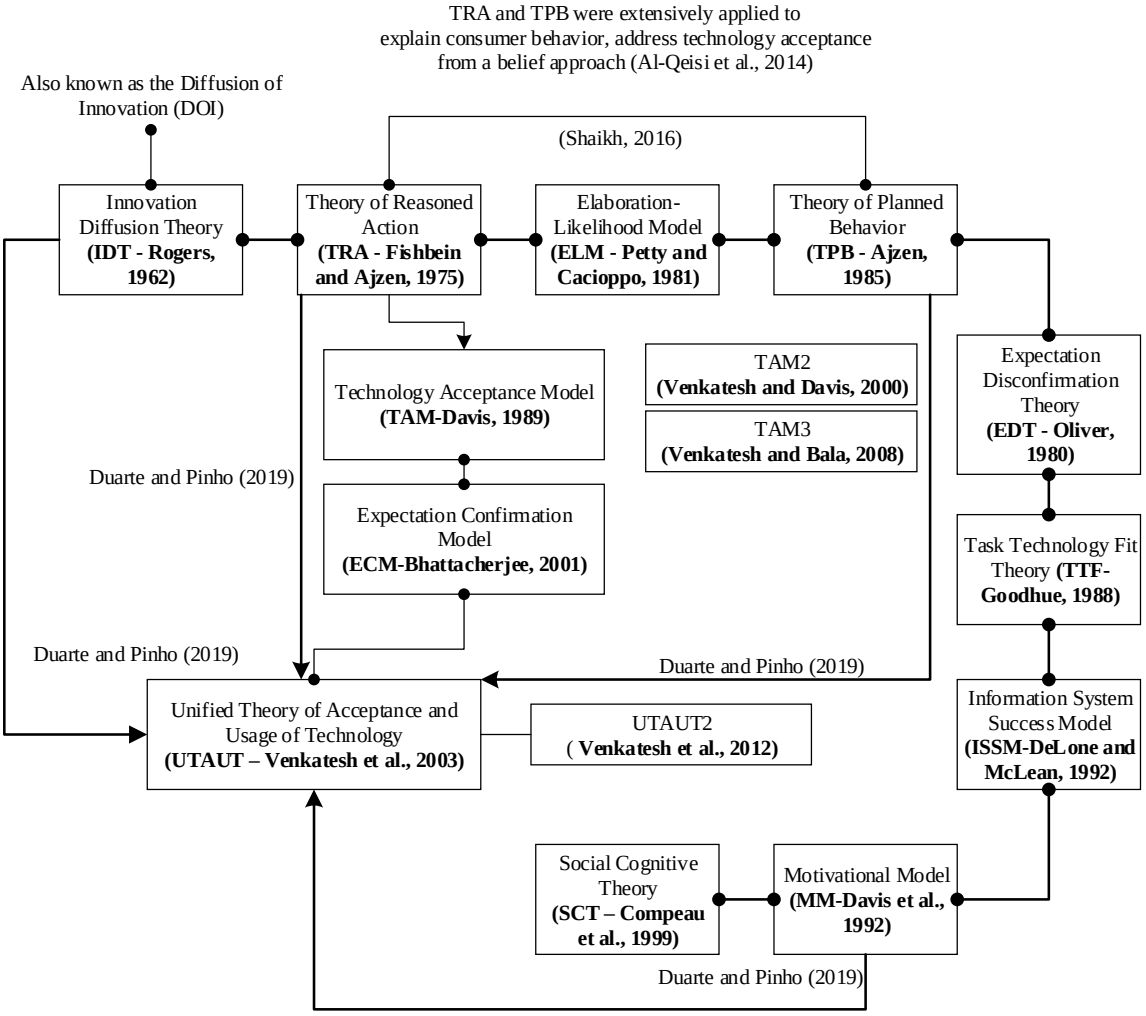
Scholars in the information systems (IS), marketing, and psychology fields have investigated the social, economic, political, and cultural factors affecting consumer adoption and usage intentions and behaviors regarding products, services, systems, and technologies in developed, developing, and emerging countries (Friederike, Maria, Andrea & Angelika, 2017; Lekhanya, 2013; Shaikh & Karjaluoto, 2015). Nonetheless, successful planning, development, and deployment of technology can be difficult due to social complexity (Bradley, 2009). Overcoming these complexities requires theoretical models, theories, and frameworks to better understand the factors and the outcome variables that affect and predict human and user behaviors, attitudes, and beliefs regarding technology adoption, especially in developing and emerging countries.

The literature offers a number of models, theories, and frameworks thoughtfully designed and used by scholars to examine and understand consumer and user acceptance and usage of technology innovations and features (Lim & Ting, 2012): innovation diffusion theory (IDT; Rogers, 1962), a theory of reasonable action (TRA; Fishbein & Ajzen, 1975), elaboration-likelihood model (Cacioppo & Petty, 1981), a theory of planned behavior (TPB; Ajzen, 1991), expectation disconfirmation theory (Oliver, 1980), task technology fit theory (TTF; Goodhue, 1988), technology acceptance model (TAM; Davis, 1989; Davis, Bogozzi & Warshaw, 1989; Hu, Al-Gahtani & Hu, 2014), and unified theory of acceptance and use of technology (UTAUT; Venkatesh, Morris, Davis & Davis, 2003), among many others. TRA, originally developed and used in social psychology research (Shaikh, 2016), is largely considered to be the "mother of the theories" because it has influenced the development of other popular theories. The information-technology-specific variants of this theory include TPB, TAM, and ECM. Figure 1 depicts a summary of the theories, models, and frameworks proposed and used over the past eight decades.

The purpose of developing and proposing these models, theories, and frameworks has been to answer vital questions. How can products, services, and ideas gain momentum and diffuse through specific populations and social systems over time (Shaikh, 2016)? Why do people accept or reject IS (Szajna, 1996)? How do the TAM and TPB constructs explain the adoption of technology and services in developing countries (Glavee-Geo, Shaikh & Karjaluoto, 2017)?

For years, academic scholars have applied these theories to describe and explain acceptance and continuous usage of technology from both consumer and organization perspectives (Glavee-Geo et al., 2017; Lai, 2017; Lee, Kozar & Larsen, 2003; Lim & Ting, 2012; Rose & Straub, 1998). Such use has made these theories, models, and frameworks important components, especially in the IS and marketing disciplines. For example, TAM, developed in 1989, has been widely deployed and cited, with its limitations

noted (Bradley, 2009; Jokonya, 2017; Lee et al., 2003; Surendran, 2012; Lippert & Volkmar, 2007). The revised TAM2 eliminates some of these limitations. Introduced by Venkatesh and Davis (2000), TAM2 addresses pre-and post-implementation beliefs and behaviors separately and is generally considered to be more concise and easier to understand and use (Szajna, 1996). Despite these improvements, these models in practice miss some aspects of social reality. For example, first, the adoption of technology depends on individual behaviors, which define individual interests, feelings, and thoughts (Bradley, 2009). Second, facilitating and administering innovative technology within local contexts in emerging and developing countries remains challenging (Dahlman, 2007). Third, a brief review conducted by the authors suggests that these models cannot capture or represent the cultures and social aspects of consumers and users.



Source: the study.

Figure 1: Snapshot of theories, models, and frameworks proposed and used over the last eight decades.

Given these limitations, it is believed that the cultural factors influencing users must be captured and represented in a revised adoption model to consider all individual interests in different societal contexts such as developing and emerging countries. Such consideration allows the development of a reflective system based on individual preferences and social and cultural values. After an in-depth analysis of the contemporary and past literature on technology adoption theories, models, and frameworks, this paper presents a novel revised TAM to capture and present technology to individuals and to understand the social and cultural factors that affect technology adoption. This study identifies the gaps in these models, theories, and frameworks and proposes the revised TAM as an ideal model for achieving culture-tech initiatives in emerging and developing countries.

Culture-tech initiatives aim to decolonize technology systems and their contents and features to meet the needs and expectations of common users in emerging and developing countries. Cultures shape individual perceptions, behaviors, and attitudes toward the usage of any form of technology. Technology adoption, therefore, must capture and represent the influencing cultural factors to consider all individual interests. Technology is used and applied in an environment controlled by cultural, social, economic, and political factors.

This study involved a literature review in facilitating an in-depth analysis of the different technology adoption models, theories, and frameworks used to predict technology acceptance and usage in the recent past. The literature review targeted papers on theories, models, and frameworks used to predict and understand factors and issues affecting technology adoption globally. The

keywords used to search for and identify relevant literature in both vertical (ScienceDirect) and horizontal (Google Scholar) search engines included "theories + adoption + technology," "models, frameworks, adoption, technology," and "technology acceptance model" in addition to other related terms. In total, 55 articles were found. After the initial screening and consideration of the purpose and scope of this study, 46 articles were shortlisted and included in this review. To interpret the data effectively, two authors were involved in coding the selected literature.

The following sections discuss the literature, research methodology, and revised TAM, including its applications. The final section presents the study's implications, limitations, and suggested future research directions.

TECHNOLOGY ACCEPTANCE AND USAGE MODELS AND THEIR MODIFICATIONS

Theory of Reasonable Action and Theory of Planned Behavior

TRA, introduced by Fishbein and Ajzen (1975), is among the most widely used theories to determine individual motivational factors, behavioral intentions, and attitudes toward actual behaviors (Bradley, 2009; Lai, 2017; Taherdoost, 2018). Both TRA and TPB (Ajzen, 1991) were initially developed and used in social psychology research (Shaikh, 2016). Lai (2017) defined consumer attitudes as emotive reactions to behaviors based on belief systems and argued that personal attitudes toward technology are affected by perceptions, and attitudes are influenced by belief systems that define behaviors (Lai, 2017). Individual and collective cultures shape the four cardinal pillars of individual relationships to technology: perceptions, attitudes, belief systems, and behaviors. The first three pillars affect actual behaviors. However, prior research has proposed that current technology platforms such as electronic learning lack cultural attributes that significantly influence user perceptions, attitudes, beliefs, and actual behaviors (Joshua, Nehemiah & Ernest, 2015).

In contrast, TPB determines factors that influence behavioral intentions motivating individual attitudes toward actual behaviors (Lai, 2017). Another factor in TPB is perceived behavioral control, or the definition of actual behaviors by individual perceptions (Lai, 2017). In general, TPB addresses situations in which individuals have no personal behavioral control (Bradley, 2009). Individual behavioral intentions are functions of user attitudes, perceived behavioral control, and subjective norms, while behaviors determine actual usage.

Technology Acceptance Model and Its Modifications (TAM, TAM2, and TAM3)

TRA, introducTAM, as discussed in this study, was introduced by Davis (1989) with the underlying purpose to model technology use in the workplace (Al-Qeisi, Dennis, Alamanos & Jayawardhena, 2014). However, it is widely believed that the motivation and theoretical grounding for TAM came from TRA; in other words, the fundamental ideas for developing TAM were consistent with TRA, which holds that attitudes and intentions determine beliefs. TAM was specifically developed to predict end users' computer and IS adoption behaviors and posits that individual behavioral intentions to adopt IS are determined by two beliefs: perceived usefulness and perceived ease of use (Shaikh, 2016). Later, Venkatesh et al. (2003) developed UTAUT with two variables: performance expectancy and effort expectancy. Performance expectancy is considered to be similar to the antecedent perceived usefulness in TAM and effort expectancy to the antecedent perceived ease of use. Venkatesh and Davis (2000) developed the modified TAM2 almost a decade later, while Venkatesh and Bala (2008) introduced TAM3 in 2008.

Initially, TAM was developed to explain computer usage behaviors (Lai, 2017). TAM was aimed at determining factors associated with technology adoption and user behaviors across different populations of technology users (Lai, 2017). Perceived usefulness focuses on users' views of the potential of new technological platforms to advance their activities, while perceived ease of use refers to the extent that potential users expect systems to be user-friendly and effortless to use (Lai, 2017; Lim & Ting, 2012). In this study, perceived usefulness is believed to be a determining factor of technology usefulness, while perceived ease of use determines perceptions of technology as effortless and user friendly.

TAM2 assesses the mental readiness of users and the consequences of using systems to carry out tasks that define customer perceptions of usefulness. Findings have shown that TAM2 is suitable for mandatory and voluntary environments (Lai, 2017), and it has been tested in different technology contexts such as internet banking (Chan, 2004). In 2008, Venkatesh and Bala (2008) developed the technology acceptance model TAM3, which has four aspects that determine perceived usefulness and perceived ease of use: system characteristics, individual differences, facilitating conditions, and social influences (Lai, 2017).

Task-Technology Fit Theory

Goodhue (1988) developed TTF with a focus on individual impacts (Lai, 2017). Put merely, TTF measures the fit between a task and technology. TTF was initially developed to evaluate workplace technology and IS adoption and its impacts on user performance (Shaikh, 2016). Instead of the antecedent fit, antecedent compatibility has been used extensively in recent research (Lai, 2017).

TTF describes technology that perfectly fits individual tasks. The model is aimed at improving and advancing adoption possibilities and increasing performance levels because technology meets user needs (Lai, 2017). TTF is used to investigate existing technology performance measures, marketplace support, and individual tasks. Its primary focus is to increase the efficiency, effectiveness, and quality of technology at meeting user needs.

Since its formulation, many scholars have applied TTF in different disciplines. For example, D'Ambra, Wilson, and Akter (2013) used it to describe, understand, and evaluate the academic use of e-books. Tripathi and Jigeesh (2015) used TTF and other theories to evaluate cloud computing adoption in multinational IT companies. However, TTF theorists and other scholars applying it have failed to describe and capture user cultures, beliefs, and other social attributes (Tripathi & Jigeesh, 2015).

Unified Theory of Acceptance and Use of Technology and Its Modifications

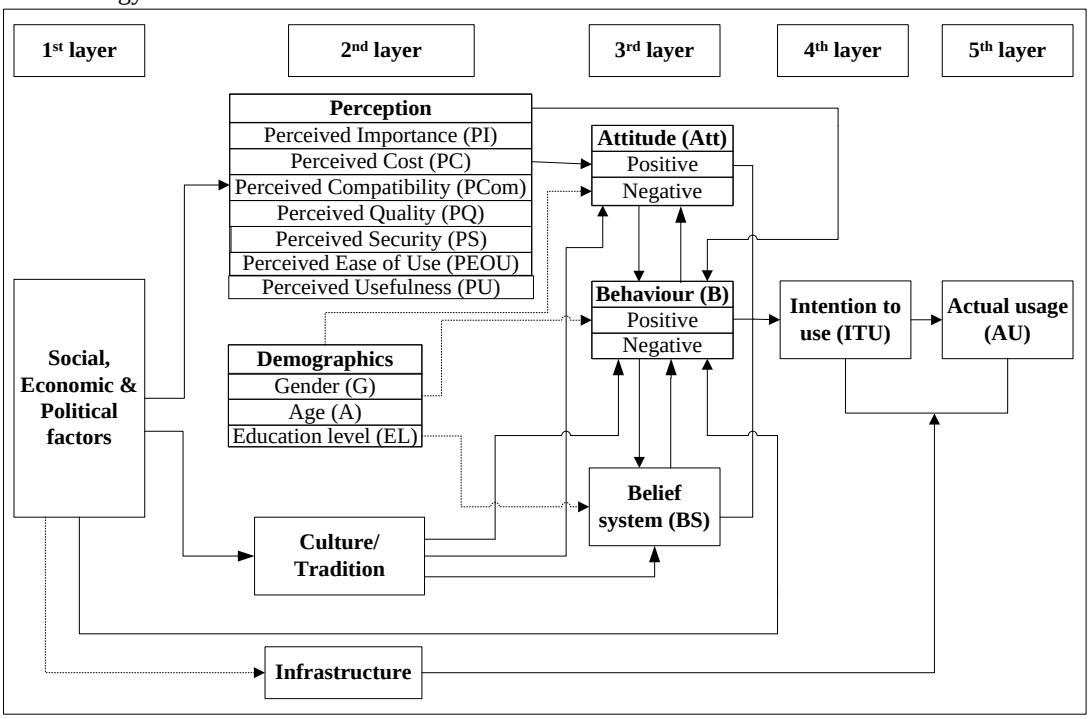
Gaps in previous studies, theories, and models necessitated the development of UTAUT by Venkatesh et al. (2003). According to Duarte and Pinho (2019), earlier models such as TRA, TAM, Motivational Model (MM), TPB, and IDT informed the development of UTAUT, which has superior explanation power compared to these well-established models (Lee & Rho, 2013).

UTAUT is grounded in four constructs that influence user behavioral intention predictors and actual technology usage: effort expectancy, performance expectancy, facilitating conditions, and social influence (Bradley, 2009; Lai, 2017). The model also has four moderators: age, gender, experience, and voluntariness (Duarte & Pinho, 2019). Effort expectancy controls perceived ease of use of technology, while performance expectancy constitutes perceived usefulness, job fit, extrinsic motivation, relative advantage, and system outcome expectancy (Lai, 2017). Performance expectancy thus is defined as the degree to which using systems and technology help users perform certain activities (Al-Qeisi et al., 2014). Facilitating conditions define user perceptions of the infrastructure, resources, and support available from service providers and governments to perform behaviors, such as using systems whenever necessary (Shaikh, 2016). Similar to the antecedent subjective and social norms in TRA introduced by Fishbein and Ajzen (1975), social influence is the extent to which consumers believe that important others (family and friends) think they should use particular technology and systems (Brown & Venkatesh, 2005; Venkatesh et al., 2003)

Recently, Venkatesh et al. (2012) proposed a revised model, UTAUT2, which includes three new constructs: hedonic motivation, price value, and habit (Duarte & Pinho, 2019). The combination of UTAUT and UTAUT2 is intended to predict human and user behavioral intentions regarding technology usage from the perspective of Performance Expectancy (PE) (Chang, 2012). We are applying both yields predictions based on a better understanding of the issues that facilitates technology and system adoption.

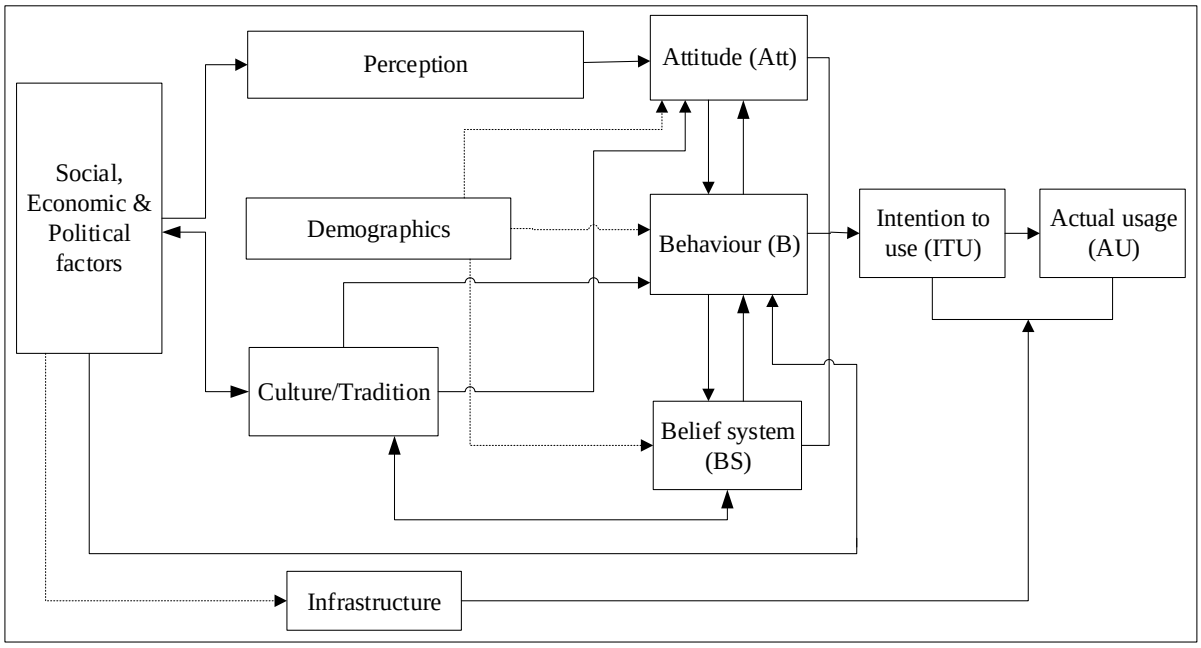
DEVELOPMENT OF THE REVISED TAM

As seen in Figure 2, the revised TAM holds that actual technology adoption is determined by technology's constructs and components. The revised TAM focuses on grassroots factors and constructs that define individual and organizational ideas, concepts, perceptions, attitudes, behaviors, and intentions to use culture-embedded cutting-edge technology. The TAM is primarily suitable for developing and emerging countries but can also be applied to developed countries. As observed, existing models, theories, and frameworks are generic in nature, whereas the revised TAM is specific. Many users adopt technology for various reasons, so these models, theories, and frameworks (Figure 1) are aimed at determining user intentions, behaviors, and actual adoption and usage of technology, applications, and systems. However, none or few of these models, theories, and frameworks focus on the indigenous technology characteristics of users in middle-income and developing countries as a means to deliver culture-oriented technology (culture-tech). Companies often invest in new technology when users are not ready to adopt it (Bradley, 2009). The revised TAM, therefore, could be useful to avoid unacceptance, resistance, and rejection of investments in technology.



Source: This study.

Figure 2: Revised technology adoption model (TAM).



Source: This study.
Figure 3: Revised technology adoption model (TAM), abridged.

As shown in Figure 2, the revised TAM is divided into five layers intended to organize and group the model into independent but connected structures. The connections are illustrated with arrows. Bolder arrows indicate strong relationships, and dotted arrows show weak, variable relationships, meaning that demographic factors and their associated constructs may or may not influence each other. Developing countries face social, economic, and political challenges such as a lack of infrastructure that directly and indirectly affect the wellbeing of consumers, users, and citizens. As technology evolves, these three factors, along with infrastructure, are the main motivations for individuals and organizations to adopt and use cutting-edge technologies. The three factors are the most challenging issues confronting developing and emerging countries in the 21st century.

The first layer in the revised TAM consists of enablers driving user perceptions, cultures, and traditions surrounding technology in middle-income and developing countries. The second layer encompasses perceptions alluded to by TAM and other components missing from existing theories, models, and frameworks that define the individual attributes determining technology acceptance in developing and emerging countries. An abridged revised TAM in Figure 3 provides a summary of Figure 2 to simplify the understanding of the model for readers and developers.

First Layer: Social, Economic, and Political Factors

Research has proven that technology adoption depends on more than user attitudes, and the modified TAM2 suggests that external variables influence technology adoption but does not analyze these variables in depth (Lai, 2017; Talukder, 2012). Thus, in Figure 2, social, economic, and political factors are the first layer in the adoption of technologies, applications, and systems, especially in developing and emerging countries. This layer is a determinant in technology adoption predictor processes (Chieochan, Lindley & Dunn, 2000). To elaborate, social factors directly affect technology adoption by individuals through societal and natural changes within their environments (Friederike et al., 2017). In this study, social factors and attributes influence the existence of a person; however, the culture and its attributes direct and guide social factors in developing and emerging countries.

Economic issues directly influence technology use. In a scholarly explanation (Kipsoi, Chang'ach & Sang, 2012), economic factors are monetary issues that affect buyers' decisions regarding satisfying buying expectations. These factors involve initial spending and returns on investment. Kipsoi et al. (2012) proposed that economic crises can reduce individual spending capacity, so economic factors are determinants of technology innovations and device purchases. However, middle-income and developing countries are financially insufficient, restricting their actions and purchasing power. In this paper, economic issues encompass monetary issues that affect individual buying power to acquire new technologies.

Political factors are government policies, legislation, and actions that guide citizens. The quest to adopt technology raises political questions. The government ensures the environment necessary to acquire, access, and use technology for social and economic improvements (Ejiaku, 2014). A peaceful, suitable government or good governance promotes and provides a happier society, which enables citizens to explore new and existing innovations and vice versa. According to Friederike et al. (2017), political factors involve policies and legislation that influence technology development and adoption. This paper follows the definitions of political factors from Ejiaku (2014) and Friederike et al. (2017). Research has shown that developing countries are poor at

forming innovative technology policies (Ejiaku, 2014). The researcher further believes that governments in developing countries might recognize their weak policies but still do nothing to address them.

Second Layer: Perceptions, Demographics, Culture, Traditions, and Infrastructure

The second layer consists of the perceptions, demographic characteristics, cultures, traditions, and infrastructure that are important influences on the adoption of cutting-edge technology by those in middle-income and developing countries. These independent variables shape define user intentions to use and adopt cutting-edge technology in developing countries.

Perceptions refer to individual views on the adoption of cutting-edge technology. The perceived components of technology are importance, cost, compatibility, quality, security, and ease of use. These components are intrinsic in the nature of adopting technology innovations.

Perceived importance

This component refers to the extent to which individuals feel that adopting technology will improve their activities (Fathema, Shannon, & Ross, 2015; Sharma & Chandel, 2013; Sharma & Mishra, 2014; Venkatesh & Bala, 2008). Perceived importance is significantly influenced by social and economic factors. Generally, potential users of technology in developing and emerging countries consider its importance to advance knowledge and ideas and to fulfill desired aims and expectations. Perceived importance thus is the positive belief that cutting-edge technology will effectively improve personal-life activities based on social and economic factors.

Perceived cost

Cost-benefit and cost-to-purchase ratios affect the adoption of cutting-edge technology (Friederike et al., 2017). Users believe that technology costs play a determinant role in the adoption process (Nyagar, Korir & Nyangweso, 2017). Friederike et al. (2017), due to economic challenges confronting middle-income and developing countries, their citizens often experience financial instability and have limited purchasing power for advanced technology. They face a dilemma of whether to acquire basic commodities and technology. This paper draws on the idea of Friederike et al. (2017) that perceived costs affect the ability to acquire technology in developing and middle-income countries. High costs may deter acquiring new technology, while low costs may encourage it.

Perceived compatibility

This component refers to the compatibility of technology with personal cultures and traditions and the accomplishment of tasks. Potential users need to determine technology compatibility before making decisions. Positive assessments of compatibility promote better attitudes. In this paper, the perceived compatibility of technology determines whether users adopt it.

Perceived quality

This component refers to the degree to which individuals believe that technology will last for a long time and achieve the desired expectations. Perceived quality further relates to the quality and standard of technology. Researchers have viewed perceived quality as assessments of actually desired features (example, reliability, system response time, adaptability, and availability (Fathema et al., 2015). The researcher also suggests that potential users evaluate cost against quality, and economic conditions determine whether users acquire good-quality devices. In this study, therefore, quality is a determinant of technology adoption behaviors.

Perceived security

This component refers to the extent to which technology is considered to be secure. Personal security plays a very important role in individual technological adoption, as it involves personal particulars. Security concerns shape user attitudes, and Lai (2017) argued that security concerns, directly and indirectly, affect user intentions. According to the stimulus theoretical framework, security is a function of perceived usefulness and ease of use (Lai, 2017). In this study, it is essential to consider personal security in technology adoption as personal information should be secure and confidential. Personal security thus deals with safety considerations that further affect behaviors, intentions, and actual technology adoption.

Perceived ease of use

This component influences the main concerns in technology adoption (Friederike et al., 2017). It refers to the personal judgment that technology can be used effortlessly to execute tasks (Fathema et al., 2015; Sharma & Chandel, 2013; Sharma & Mishra, 2014). The easier using technology is perceived, the more likely users are to adopt it. Users have high chances of adopting technology that they perceive as easy to use effortlessly. Citizens in middle-income and developing countries thus prefer to see that it is easy to use technology to meet their needs and expectations. Users' general belief systems are positive determinants of the perceived ease of use of systems (Venkatesh & Bala, 2008), while, in turn, defining the behavioral intention (BI) and actual usage (AU) of cutting-edge technology (Bradley, 2009).

Perceived usefulness

This component refers to end users' belief that a new technological platform will advance and support their daily activities (Lai, 2017; Lim & Ting, 2012). According to Davis (1989), perceived usefulness improves confidence in information technology's capacity to improve individual job productivity, effectiveness, and performance. Perceived usefulness supports high levels of

internal consistency and competence in users (Legrisa, Inghamb, & Collerettec, 2003). Beliefs motivate users' adoption of cutting-edge technology in developing and emerging countries. Their beliefs also define their technology adoption attitudes and behavioral intentions (Bradley, 2009). In this study, perceived usefulness is believed to be a determining factor in the perceived ease of use of technology.

Demographics

The factors affecting technology adoption encompass demographic characteristics and direct personal attributes. The demographic characteristics in the second layer of the revised TAM include gender, age, and education, among others. These demographic factors indirectly (see the dotted lines in Figures 1 and 2) affect user attitudes, behaviors, and belief systems regarding the adoption of various products, services, systems, applications, and technologies such as smartphones.

Gender is a personal attribute organized into males and females and affects individual social consciousness and actions. This factor influences the adoption of cutting-edge technology, which affects its positive actual or final usage (Bradley, 2009). Lee et al. (2003) suggested that gender controls social factors, perceived importance, and perceived ease of use. However, Bradley (2009) stated that gender has no direct impacts on perceived importance and perceived ease of use related to technology adoption. In this paper, gender is held to affect individual attitudes, behaviors, and belief systems toward cutting-edge technology adoption.

Age is a crucial demographic factor in technology adoption, especially in middle-income and developing countries where older generations are tech-naïve and younger generations are tech-oriented (Friederike et al., 2017). Older generations must adjust to technology, although age cannot hinder interest in technology adoption (Friederike et al., 2017). In this paper, age is treated as a crucial determinant of the adoption of cutting-edge technology. Younger generations are more tech-oriented than older generations, so individual age affects technology adoption. Age can be a determinant of behaviors and intentions.

In another fundamental influence on users' technology attitudes, increasing education levels foster positive attitudes toward cutting-edge technology (Friederike et al., 2017). It can be confirmed that, in general, the education levels of citizens in middle-income and developing countries affect their attitudes toward cutting-edge technology (Friederike et al., 2017). Individuals' education levels shape their technology acceptance attitudes.

Cultures and traditions

The Merriam-webster.com dictionary defined culture as "the set of shared attitudes, values, goals, and practices that characterizes an institution or organization."(merriam-webster.com, n.d). While Chukwuere, Mavetera, and Mnkandla (2016) described culture as the common values, knowledge, industries, talents, and civilization connecting people in a particular environment. These values and knowledge control the systematic norms of how people view and accept knowledge (Lekhanya, 2013; Chukwuere et al., 2016). Technology is not a historically inherited device in developing countries, so for it to be adopted and used, developers must understand and recognize users' cultural values and standards (Lekhanya, 2013). Accordingly, Lekhanya (2013) believed that a society's culture is fundamental to the acceptance of technological innovations in middle-income and developing countries. This statement shows that culture is regarded as a key element in human expression (Lekhanya, 2013). In this study, culture controls and influences users' views, actions, and perceptions of the use and adoption of cutting-edge technologies.

Traditions can be referring to long-standing "cultural practices" by groups of people in a given society (Maluleke, 2012). Cultures and traditions involve history, language, lifestyle, values, food, and dressing patterns. These long-standing values can be changed, not overnight but through a gradual process. Such practices in the dominant culture can spur resistance to technology adoption and use. Overcoming this barrier to deliver technology innovation can be complex, but developers should seek to understand these barriers through this innovative model. Cultural elements influence the chances of technology adoption (Lekhanya, 2013). In this study, cultures, traditions, and social, economic, and political (SEP) factors mutually influence each other. Furthermore, cultures and traditions influence perceptions, behaviors, and belief systems, which are fundamental individual predictors of the adoption of cutting-edge technology in middle-income and developing countries.

As Figure 1 illustrates, infrastructure is an enabler of use intentions and actual technology usage. In Figure 6, a dotted line connecting SEP factors and infrastructure indicates a partial relationship. The connection mainly shows that economic and political factors may affect technology infrastructure development and standards in developing countries.

Infrastructure

Technology infrastructure involves computers, Internet access, software, and other components (Ejiaku, 2014). Standard infrastructure affects engineers' positive intentions to use and adopt technology in middle-income and developing countries. Kipsoi et al. (2012) argued that infrastructure in middle-income and developing countries falls below standards and fails to promote technological innovations. The lack of infrastructure includes high Internet costs, unreliable computer equipment, and a lack of telecenters, a steady power supply (electricity), and technical support in communities, among others. Access to technology infrastructure is low; for example, only 1% of people in Africa use the Internet (Kipsoi et al., 2012). Poor infrastructure conditions make access to information costly and limited. Technology infrastructure lags behind due to poor government policies and limited investment (Ejiaku, 2014). In this study, infrastructure is a function of technological adoption.

Third Layer: Attitudes, Behaviors, and Belief Systems

The third layer encompasses user attitudes, behaviors, and belief systems regarding technology adoption in developing countries. Attitudes refer to positive and negative beliefs about carrying out particular behaviors (Chuttur, 2009). Sharma and Mishra (2014) defined attitudes as the degree of belief in certain behaviors, while Lai (2017) viewed attitudes as personal assessments of objects. User attitudes toward technology are a function of technology's perceived importance and ease of use, which shapes real behaviors (Fathema et al., 2015). Attitudes toward technology are affected by user beliefs, use intentions, gender, age, education levels, and general behaviors. Before developing positive attitudes, users must develop good intentions. In this study, attitudes determine behaviors, which affect beliefs.

Behaviors are the "result or intention" of attitudes (Lai, 2017). In this study, behaviors can be positive or negative and are measured by their frequency, duration, number, and multiplicity of use (Lee et al., 2003). Behaviors determine what a person would like to do (attitudes) and think should be done (social norms; Sharma & Mishra, 2014). Positive behaviors affect users' intentions to use technology, while negative behaviors promote anxiety regarding technology (Sharma & Mishra, 2014). Figure 6 shows that behaviors can be positive or negative, influencing actual behaviors toward technology adoption. Sharma and Mishra (2014) further believed that behaviors are influenced by outcome expectations and performance outcomes. Behaviors are intentional influences on user technology adoption. Furthermore, behaviors are driven by perceived importance and ease of use (Venkatesh & Bala, 2008). Consequently, individuals' belief systems determine their personal behaviors toward technology.

Belief systems are the cognitive aspect of individual attitudes (Sharma & Mishra, 2014). Lai (2017) defined beliefs as associations between objects and attributes. Beliefs draw upon two aspects of behavioral intention: perceived importance and perceived ease of use (Venkatesh & Bala, 2008). In this study, beliefs are considered to be elements of personal cultures, traditions, demographics, and behaviors that shape perceptions of technology. Beliefs are also a state of belief in something. Any personal belief about technology can be influenced by factors, including society, economics, politics, infrastructure, culture, and traditions.

Fourth Layer: Intentions to Use

Intentions to use compose the fourth layer of the revised TAM that encompasses the intrinsic aspects of a person. Personal intentions are defined as individual behaviors that shape intentions to use (Fathema et al., 2015). Regarding the revised TAM and ITU, cutting-edge technology depends on the behavioral change of a user, which is a function of personal attitudes, behaviors, beliefs, and infrastructure. In this study, intentions to use are the main motivations for the use of cutting-edge technology to accomplish personal and organizational tasks.

Fifth Layer: Actual Usage

Gaps in previous studies, Actual usage forms part of the fifth and final layer of the revised TAM and is defined as the actual use or adoption of technology innovation by individuals or organizations. The effective functioning of the fifth layer is entirely dependent on the first, second, third, and fourth layers. Both layers promote better actual usage of any technology in middle-income and developing countries. The layers components are a function of behavioral intentions to use technology (Bradley, 2009). In this study, the actual usage is the act of the effective application of technology to achieve the desired aims. Actual usage shows that individual use of any system results from individual changes in behaviors that lead to final usage.

In summary, in the revised TAM, cutting-edge technology's actual usage and adoption are functions of SEP factors, perceptions, demographic characteristics, cultures, traditions, infrastructure, attitudes, behaviors, belief systems, and intentions to use (see Figure 1).

APPLICATIONS OF REVISED TAM

The main purpose of the application of technology acceptance models and theories to IS and other disciplines over the decades has been to determine the influence of users' behaviors in technology adoption. The revised TAM, in particular, is intended to assist middle-income and developing countries' users and organizations in adopting cutting-edge technology. The revised TAM has broader applicability as it is more current and concise based on in-depth analysis and evaluation of the different models and theories applied in social sciences research and in real life. The revised TAM is more robust for use and applicable across countries and contexts, especially middle-income and developing nations.

The revised TAM has various applications. First, it can be applied to given populations based on country, community, demographic characteristics, social group, educational institutions, and other factors. The revised TAM is intended to understand the underpinning factors of users' behavioral intentions that affect the adoption of cutting-edge technology, particularly in middle-income and developing countries. The revised TAM is well suited to analyze technology-associated behavioral intentions and actual use of technology and systems. Second, the revised TAM can be vital for researchers investigating and applying technology adoption models and theories to understand cultural and general factors and components that affect acceptance of technology and computer-related systems in middle-income and developing countries.

Third, the revised TAM can be applied across academic disciplines (e.g., the social sciences, education, and humanities) and organizations to evaluate technology-related contexts. Moreover, the model is intended to deliver consumer-oriented technologies within culture-tech contexts and markets.

CONCLUSION

Developing countries often confront social, economic, and political challenges and a lack of infrastructure, which hamper the diffusion of technological innovations. In recent decades, many models and theories have been developed to identify the factors that determine individual acceptance and continuous usage of technology. This literature review served the purpose of developing and proposing a revised TAM that describes the factors and layers that affect the adoption, usage, and diffusion of technology, applications, and systems in developing and emerging countries. These factors and components are essential to promote culture-tech initiatives as the underpinning cultural factors are regarded as impediments to technological adoption in developing and emerging countries and, therefore, should be considered. The application of the revised TAM by technology developers will promote the inclusion of the personal, social, economic, and political attributes of users in developing and emerging countries. The revised TAM considers and integrates issues pertaining to users in developing and emerging countries.

THEORETICAL CONTRIBUTIONS AND LIMITATIONS

This study is not without limitations. The revised TAM can be regarded as a conceptual idea that researchers can apply to determine its effectiveness at managing the adoption of technology, applications, and systems, specifically by users in developing and emerging countries. The proposed model is yet to be tested but is empirically relevant. In summary, it is recommended that the revised TAM components should be thoroughly tested to determine their effectiveness in real-life technology development, design, and adoption and in academic and scientific research.

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