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TOWARD A FIRM TECHNOLOGY ADOPTION MODEL (F-TAM) IN A DEVELOPING COUNTRY CONTEXT

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Abstract

The diffusion of digital innovations among SMEs in developing countries like Ghana is slow due to several factors. Well-known adoption models appear to have often been from developed country contexts and have proposed antecedents of behavioral intention instead of actual adoption. Consequently, many variables from existing models have been present in developing country contexts such as Ghana and yet most digital innovations have not been adopted. A systematic literature review is employed to explore the contexts within which earlier models of technology adoption were developed, and to build a revised model of factors that lead to actual adoption in a developing country context. The results indicate that acknowledged models were developed from contexts that are different from that of Ghana. The study improves the existing knowledge gap of antecedents of adoption in a developing country context. The model provides the reference factors that SMEs and governments must ensure that they enhance adoption of innovations.

Key Words: Digital innovations, mobile technologies, adoption, diffusion, developing country

1. Introduction

Small to Medium Enterprises (SMEs) who form over ninety percent of business units in Ghana have been hailed to be the backbone of the private sector in any economy (Bannock, 2005). Empowered SMEs will, therefore, support the overall economies of developing countries where governments are resource challenged in providing basic social services. One way SMEs can be empowered is to stimulate the adoption of digital innovations. The diffusion of digital innovative technologies itself among SMEs in developing countries, such as Ghana, is slow due to several factors such as poverty, cultural dynamics, and resource challenges (Boateng, Hinson, Heeks & Molla, 2008; Essegbey & Frempong, 2011). If the adoption of digital innovations will accelerate Ghana's development process (Fuchs & Horak 2008; Boateng et al. 2008), then, in spite of the difficulties mentioned in Datta (2011), Essegbey & Frempong, (2011) Moyo (2013), Namara et al. (2014) and Dary, and Issahaku (2013), the factors that engenders actual adoption needs to be uncovered for application unto further innovations among SMEs who form over ninety percent (90%) of business units in Ghana.

Various studies have developed models of adoption of digital technologies (Venkatesh & Bala, 2008; Fishbein & Ajzen, 1975; Ajzen, 2015; Taylor & Todd, 1995; Venkatesh, Thong & Xu, 2012; Tornatzky & Fleischer, 1990). These models, however, have often posited antecedents of behavioral intention. They have also posited variables at different levels in isolation of personal level model, firm level model and societal level model. Consequently, many of the variables from those models have been present in a developing country context, yet many digital innovations have not been widely

adopted in developing countries (Datta, 2011). If the variables in the models are expected to be universal, then have developing country contexts of poverty, cultural closeness, resource challenges and low e-readiness been factored into the data collection for these earlier models? If a model is developed from a developing country context, will the antecedents of adoption explain adoption behavior better? This study develops a firm level adoption model while accounting for the influence of personal level factors as well as societal level factors.

Mobile technologies in Ghana have diffused to a large extent (Frempong, 2009) with a total mobile phone subscription rate of 36,138,706 subscribers as at the first quarter of 2016 (National Communications Authority (N.C.A), 2016), representing a mobile subscription rate of 130.97%. Allied digital innovation such as mobile payment systems have realized a total subscription rate of 14,697,570 as at the first quarter of 2016 (N.C.A, 2016), and its expansion has become a topical issue for discussion in Ghana today (Asongu, 2015; Attopley, 2016; James, 2016; Tagoe, 2016; Bank of Ghana, 2016, *www.ghana.gov.gh: guidelines to regulate mobile financial services*- accessed on 25 March, 2017). It appears that some factors explain the adoption of mobile technologies in a developing country context that are not captured in earlier models. This study, therefore, explores the factors that relate to actual firm level adoption of digital technologies, in a developing country context such as Ghana, by developing a model of factors that practically stimulated the rapid adoption of mobile technologies for application onto further technologies. This study is the first to examine the firm level adoption of innovation by taking into consideration the personal level factors and societal level factors. Others studies have looked at the variables at different levels in isolation. It is also the first attempt at building a model with data collected strictly from a developing country context. Finally, it is examining actual adoption as a follow up from Datta (2011), and not behavioral intentions. For developing countries with socio- cultural contexts such as Ghana, the authors estimate that the model will be fully applicable.

Given the above, our main aim is to develop a Firm level Digital Technology Adoption Model (F-TAM) among SMEs in Ghana. In doing so, we want to identify and validate a set of personal, organizational and societal level factors that stimulate the adoption of mobile technologies in Ghana. Hence, we address the following research questions:

(1) What factors stimulate firm level adoption of mobile technologies at the personal level?
(2) What firm level factors stimulate the adoption of mobile technologies?
(3) What societal level factors stimulate the adoption of mobile technologies at the firm level?

2. Theoretical background

2.1.The concept of digital innovation

While innovation is the creation or adoption of an idea, material artifact, behavior, product, technology, or a process that is new to the adopting unit (Gupta, Tesluk & Taylor, 2007); digital innovation is an innovation enabled by digital technologies that lead to the creation of new forms of digitalization (Yoo, Lyytinen, Boland, Berente, Gaskin, Schutz & Srinivasan, 2010). While it is true that not all digital innovations change the structure of industries, digital innovations have largely been described (Lyytinen & Rose, 2003) as disruptive (Christensen, 1997; Christensen & Raynor, 2003). A disruptive innovation is one that creates new markets and value, thereby disrupting an existing industry structure and displacing established market leaders, products, and alliances with new ones (Christensen, 1997; Christensen & Raynor, 2003).

2.2. History of digital innovations

The history and studies in digital technologies started between 1947 and1969**,** with the invention of the transistor, leading to more advanced digital computers, internet protocols, and networks. The introduction of mainframe computers and virtual memory in the 1970s revolutionized the industry. Scholarly research during the 1970s focused on the history of computing (Carlson, 1986; March, Hevner & Ram, 2000; Norberg, 2001; Galler, 2004; Aspray, 2007; Tilson, Lyytinen & Sørenson,

2010). From this period, digital technology proliferated and encouraged the switch from analog to digital record keeping to become the new standard in business. In the 1980s, computers achieved semi-ubiquity in developed countries. Industry's need for interconnectedness and academic studies precipitated the invention of the World Wide Web in 1989 (Mahoney, 1996; Tilson et al., 2010). The internet expanded quickly, and by 1996 it was part of mass culture in developed countries with many businesses listing websites in their ads. By 1999 almost every country had a type of connection, (March, Hevner & Ram, 2000). From 2000 onwards, the digital revolution became truly global, spreading to the masses in the developing world. Cell phones became ubiquitous in developed countries, just like computers, reaching a world usage of over 3 million, and internet usage population of 1 billion (Teddlie & Yu, 2007). Academic studies within this era focused mainly on the disintermediation effects of these disruptive digital innovations (Lucas & Goh, 2009). In the 2010s, widespread use and interconnectedness of mobile networked devices and mobile telephony, internet websites and resources, and social networking had become a de-facto standard in digital communication. Cloud computing had entered the mainstream industry and research, and by 2015, tablet computers and smartphones had been predicted to exceed personal computers in internet usage (Rigby, 2011; Ali, Barrdear, Clews & Southgate, 2014; Yoo, Boland, Lyytinen & Majchrzak, 2012).

Current trends in the development and research of digital technologies are in the areas of big data mining (Fan & Bifet, 2013; Wu, Zhu, Wu & Ding, 2014); cloud computing (Zhang, Cheng & Boutaba, 2010); social media (Rigby, 2011); networking (Kaplan & Haenlein, 2010; Yoo, Lyytinen, Boland & Berente, 2010); cyber security (Von-Solms & Van-Niekerk, 2013); and mobile app/technologies (Ickin, Wac, Fiedler, Janowski, Hong & Dey, 2012; Harrison, Flood & Duce, 2013; Ali, Barrdear, Clews & Southgate, 2014; Barrett, Davidson, Prabhu & Vargo, 2015). Mobile technology seems to be the typical digital innovation is widely adopted in Ghana and can be measured based on the research objective **(**Frempong, 2009; Asongu, 2015; Attopley, 2016; James, 2016; Tagoe, 2016; Zanello, 2012; NCA, 2016).

2.3.Adoption and diffusion of innovations

Adoption is the micro process through which individuals or a group of people go through in order to adopt an innovation; while diffusion, on the other hand, is a macro process that indicates how an innovation is diffused through adoption by members of a society over time (Rogers, 1962). The adoption of innovations, according to Rogers (1962, 2010) happens at the individual level, where attitudinal and perceptual factors relate directly to adoption; firm level, where internal and industry environmental characteristics relate directly to adoption; and at the societal level, where collective macro level actions relate directly to adoption. Adoption of digital innovations in developing countries is slow due to several factors specific to poor and developing countries (Datta, 2011; Essegbey & Frempong, 2011; Moyo, 2013; Namara et al., 2014; Dary & Issahaku, 2013). Apart from underutilization, these factors often lead to technological rejection and non-use (Yahaya & Ebenezer, 2012; Amoako, Doe & de-Heer, 2014).

2.4.Theories of adoption

Existing theories and models that explain the adoption of digital innovations at the persona level include the Technology Acceptance Model - TAM1, 2 & 3 (Venkatesh & Bala, 2008), Theory of Reasoned Action - TRA (Fishbein & Ajzen, 1975; Ajzen, 2015) , Theory of Planned Behaviour - TPB (Ajzen, 1985, 1991), Decomposed Theory of Planned Behavior - DTPB (Taylor & Todd, 1995); Unified Theory of Acceptance and Use of Technology - UTAUT 1 & 2 (Venkatesh, Thong & Xu, 2012), Value-Based Adoption Model - VAM (Dodds & Monroe, 1985), Motivational Model - MM, (Davis, Bagozzi & Warshaw, 1992), and the Integrated Model of Technology Acceptance - IMTA (Venkatesh, Speier & Morris, 2002). All these were developed with data from the USA, which is a developed country with an open culture and an e-readiness index of 5.6. (2015 e-Readiness Index: *http://www3.weforum.org/docs/WEF_Global_IT_Report_2015.pdf,25* March 2017) Other adoption models at the personal level Social Influence Model-SI Model (Fishbein & Ajzen, 1975; Venkatesh & Brown, 2001; Kim, Chun, & Lee, 2014), developed from literature and tested in USA and Singapore

with e-readiness index of 5.6 and 3.7 respectively (2015 e-Readiness Index), Dynamic Use Diffusion Model - DUDM (Shih, Venkatesh, Chen & Kruse, 2013) developed with data from cross cultural contexts of USA, Sweden and India, all developed countries with e-readiness indices of 5.6, 5.8, and 3.7 respectively (2015 e-Readiness Index).

At the firm level, earlier models include Technology, Organization and Environment Framework - TOE (Tornatzky, Fleischer & Chakrabarti, 1990) developed with data from the USA, a developed country with e-readiness index of 5.6; Model of Acceptance with Peer Support-MAPS, developed with data from Finland, a developed country with e-readiness index of 6.0.

At the societal level of adoption, popular models include Diffusion of Innovations Theory - DOI (Rogers, 1962), developed with data from the USA, PERM Model, Culture, Policy & Technology Framework - CPT (Bajaj & Leonard, 2004) developed from literature; Perceived Electronic Readiness Model - PERM (Molla & Licker, 2005) developed with data from South Africa, one of the emerging economies of the world (BRICKS) with e-readiness index of 4.0.

Various authors who have tested these models have customized the contexts of testing from the context of the original models, or have tested the models at different levels of adoption from the levels the original models were developed for. It appears that these theories and models have been developed with data from contexts that are materialistic, have low power distance, and avoid uncertainty, as opposed to the context of Ghana and most African countries described by Amoako, Doe and de-Heer (2014) and Shih, Venkatesh, Chen and Kruse (2013). In an attempt to address this contextual issue at the firm level, an initial set of factors that have been found to lead to actual adoption, are used to develop the F-TAM model, to be validated in industry later tested rigorously in a nationwide survey. This model examines actual firm level adoption when all three levels of factors are present in and around the firm. Thus the model examines how the adoption factors at the three levels of adoption interact to collectively influence adoption at the firm level.

2.5.Culture and context of adopting innovation

Röling et al. (2004) argued that the need to ground research in context is as strong as the need to ground research in the international scientific discourse. In this regard, Rogers (1962) views innovation and diffusion as distinct processes, treats technology innovations as a free-standing object independent and devoid of cultural meaning, and views problems of diffusion as ones of communication and persuasion. Agarwal (1983) disagreed with Rogers (1962) and argued that potential adopters' decisions concerning adoption are based on rationality embedded in culture and the context of adoption rather than persuasion. To buttress the importance of socio-cultural contexts, Kraemer et al. (1992) found in a study of computing diffusion in nine countries of the Asia-Pacific region that a country's level of computing expenditure strongly correlated with its stage of economic development. Dewan and Kraemer (2000) and Pohjola (2001) however, found that the strong relationship generally found between digital innovations and firm productivity in developed countries was mostly absent in developing countries partly due to the low unit cost of labor coupled with the relatively higher capital costs associated with IT, and the limited absorptive capacity of the societies resulting from their inadequate human resources. Fuchs & Horak (2008) for instance also noted in the context of Ghana that neoliberal policies do not guarantee increased access nor automatically close the digital divide (adoption of digital innovations) because of contextual issues that must be addressed. This socio-cultural context of adoption had been noted in Hostede (2001), and confirmed in Amoako, Doe and Deheer's (2014) study of innovation and marketing in Ghana. Thus, innovation is adopted in collective societies if it will add up to building more and more relationships (Amoako, Doe & Deheer, 2014) where the cultures are less likely to plan for long-term infrastructure that can accommodate the use of innovation (Hoyer & MacInnis, 1997, Hofstede, 2001).

3. Methods

3.1. Systematic literature review

The ABS Academic Journal Quality Guide Version 4 (2015) was used as the sample frame from which all journals that ranked 3 and 4 in the areas of innovations, ICT, entrepreneurship and small business management were listed. It was expected that the most insightful reports would be reported or mentioned within these range of journals. This query resulted in journals as shown in Table 1 below being searched. All the journals from this list were accessed in addition to Google Scholar. Keywords used to search relevant articles include ICT, digital innovations/technologies, adoptions & diffusion. The search resulted in an initial set of over 10,000 articles, which excluded papers based on their title, abstract, and full text. This also resulted in 230 articles that are grouped according to the journal source in Table 1.

Domain Ranking	Journal	No. of Articles	Domain/ Ranking	Journal	No. of Articles
Innovation			**ICT, Continuation**		
4 star	Journal of Product Innovation Management	22	3 star	European Journal of Information Systems	9
	Research Policy	13		IEEE Transactions on Software Engineering	2
3 star	R and D Management	5		Information and Management	13
Entrepreneurship & Small Bus. Mgt				Journal of Information Technology	0
4 star	Journal of Business Venturing	0		Decision Support Systems	13
	Entrepreneurship, Theory and Practice	1		Journal of the Association of Information Systems	0
3 star	International Small Business Journal	0		Expert Systems with Applications	1
	Entrepreneurship and Regional Development	6		Journal of the American Society for Information Science and Technology (JASIST)	7
	Small Business Economics	0		Information Processing and Management	0
	Journal of Small Business Management	6		International Journal of Human-Computer Studies	2
	Strategic Entrepreneurship Journal	2		Journal of Strategic Information Systems	0
	International Small Business Journal			International Journal of Electronic Commerce	0
ICT				INFORMS Journal on Computing	0
4 star	MIS Quarterly *	15		ACM Transactions on Computer-Human Interaction	7
	Information Systems Research *	1		Information and Organization	3
3 star	Journal of Management Information Systems	27		Google Scholar	25
	Information Systems Journal	11			

Table 1: Sources of articles used for Systematic Literature Review

Each article was analyzed based on relevance to digital innovations adoptions, the level of adoption, stage of theory development, socio-cultural context of theory/model, and relevance to the current study. The articles were then reduced to 31 and were analyzed with the modified form of the author-centric approach to literature analysis (Webster & Watson, 2002). In this modification, the authors extended the author-centric approach to literature analysis with the levels of analysis at which each study was conducted. Therefore the articles are grouped according to level of adoption. The constructs posited as the antecedents of adoption are indicated from each article. To arrive at the constructs in Table 2, multiple coding techniques were adopted. The three levels of adoption (Rogers 1962) are used as provisional codes (Miles, Huberman & Saldaña, 2014; Saldaña, 2015). Thus, irrespective of the theory or model, these levels of adoption codes emerged from the literature review, and are modified later using concept centric approach to listing the data and pattern coding (Saldaña, 2015). Sub-coding techniques (Miles, Huberman & Saldaña, 2014) are also used in Table 2 to classify the major constructs that serve as antecedents of adoption. Using causation coding (Miles, Huberman & Saldaña, 2014; Saldaña, 2015), a summary of causality of the provisional codes and antecedents of the sub-codes as found in the literature and outcomes of empirical reports is also listed. Finally, the socio-cultural contexts of the original constructs or variables were demonstrated. Pattern coding is used in grouping the sub-codes into major themes that depict the three levels of adoption. The constructs are developed in Table 2 and later into the conceptual framework in Figure 2 as artificial *ex-ante* artifacts (Venable, Pries-Heje & Baskerville, 2012) to be evaluated or validated as natural *ex-ante* artifacts (Venable, Pries-Heje & Baskerville, 2012) and will finally be tested on the real adopters as natural post ante artifacts (Venable, Pries-Heje & Baskerville, 2012).

3. Results

The summary of the results of the literature review and analysis are shown in the Tables 2 and figure 1 below. The author centric approach is used to classify articles in order to demonstrate the contexts of their development. In Table 2, the concept centric approach used is used to aid the pattern coding.

Cultural context of models: 91.7% of models developed at the personal level have been done in an open cultural context. The only one (DUDM) within a closed cultural context (India) was done as part of a cross-national context. Thus, no study sited has been developed completely from a closed cultural context at the personal level. At the firm level, all models developed have been from an open cultural context. The societal level however recorded 60 % for open culture, 20% (one) for closed culture, and 20% (one) from mixed cultures. Thus, models developed so far have largely been from an open cultural context.

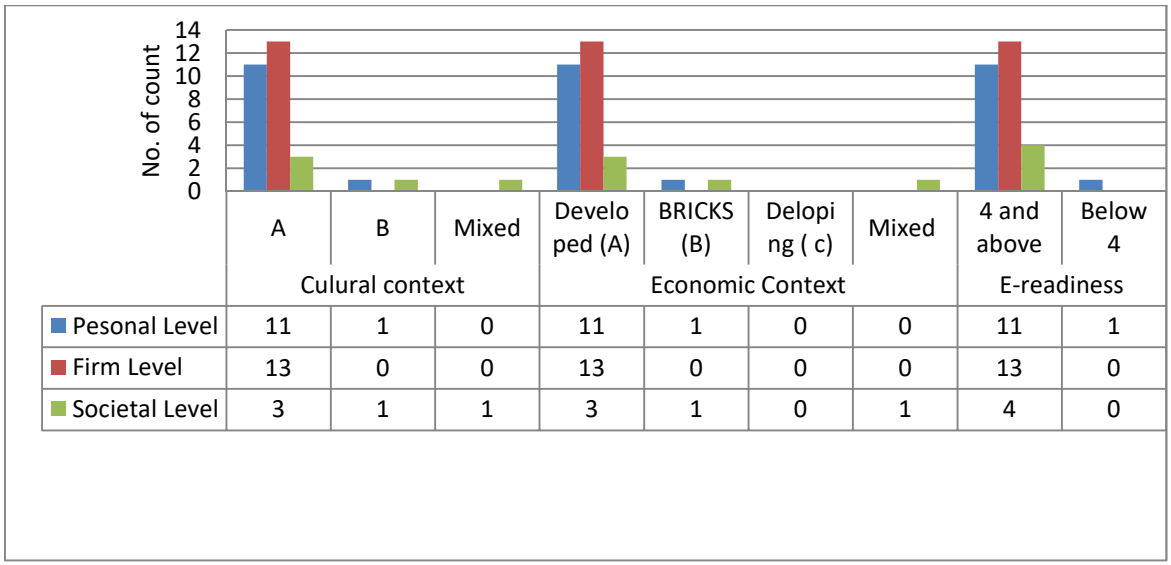
Economic Contexts: Figure 1 demonstrates that the economic contexts have been highly skewed towards developed country contexts. Approximately 93% of the models were developed or tested in a developed country context, 7% from BRIC countries and none from a developing country context.

E-readiness context: Ghana's E-readiness for 2015 is 3.5, 3.6 for 2014, and 3.5 for 2013. Statistics from the 2015 e-Readiness Index (World Economic Forum, 2015) show an average E-readiness ranking of between 2.3 and 3.5 for Sub Saharan African countries. Meanwhile the average E-readiness index for models developed so far is 5.36. In the only model (DUDM) developed with data from an E-readiness context of less than 4 (3.7), data was collected from two other E-readiness contexts of 5.8 and 6.0. This can have an effect on the strength of its generalizability in lower E-readiness contexts. Interestingly, the construct of indispensability was also posited. Thus, the models have been developed from higher E-readiness contexts than those of Sub Saharan African countries.

It is evident, therefore, that the contexts from which earlier models have been developed are different from that of Ghana and other Sub Saharan African countries. Consequently, as found in Datta (2011), the modeling of actual adoption realizes different results from behavioral intention to use.

In developing constructs for this new model, constructs that have been found in various studies to have led directly to actual adoption have been identified and summarized into an initial model in this study. These constructs were chosen based on their ability to influence adoption directly. In Table 2, these constructs are defined. The theories and models from which they are selected are indicated, alongside other theories that predict the same construct.

The contexts within which the models have been developed are displayed graphically in figure 1 below



	A	B	Mixed	Developed (A)	BRICKS (B)	Deloping (c)	Mixed	4 and above	Below 4
Pesonal Level	11	1	0	11	1	0	0	11	1
Firm Level	13	0	0	13	0	0	0	13	0
Societal Level	3	1	1	3	1	0	1	4	0

Figure 1: Graphic presentation of contexts of earlier models

Description of the context of models developed
Cultural Classifications: A= Less tolerance for ambiguity and uncertainty, B= Moderate level of tolerance for ambiguity and uncertainty, C= High level of tolerance for ambiguity and uncertainty
Economic Classifications: A= Developed Country context, B= BRICS (Emerging countries), C= Developing country contexts
E-readiness Index: 2015 e-Readiness Index Source (World Economic Forum (2015) The Global Information Technology Report http://www3.weforum.org/docs/WEF_Global_IT_Report_2015.pdf

Construct	Definition	Original Theory/ model	Other Theories / models,	Other Related Constructs
Individual level				
Perceived Usefulness (PU)	The degree to which a person believes that using a digital technology will increase his or her job performance or output (Vankatesh et al., 2003). The degree to which a person likes or dislikes the object (Ajzen & Fishbein, 1980).	TAM	TAM2 D(TPB) UTAUT MAPS, ITMA TRA VAM	Performance expectancy, cognitive instrumental processes - *job relevance, output quality, result demonstrability*, extrinsic motivates (MM, ITMA); job-fit (MPCU); outcome expectations (SCT)*;* Attitude - *relative advantage*, *complexity* and *compatibility* (TRA); Perceived Value - *an individual's overall assessment of the utility of a product/service based on the perceptions of what is received and what is given*, i.e. perceived usefulness - perceived costs (VAM)
Perceive Ease of Use (PEOU)	The degree to which a person believes that using the digital technology will be free of effort. The degree of ease associated with technology use (Vankatesh et al., 2003).	TAM	TAM2 UTAUT MAPS ITMA,	Effort expectancy, complexity (MPCU); Anchor factors - *computer self-efficacy, perceptions of external control, computer Anxiety, computer playfulness* (UTAUT*)*; Extrinsic motivation (ITMA)
Social influences	The extent to which adopter perceive that important others (e.g., family and friends) believe they should use a technology; OR The use of technology to demonstrate class boundaries or social standing (Shih, Venkatesh, -Chen & Kruse, 2013).	UTAUT	TRA, MAPS, TPB, DTPB, DOI, DUDM	Affiliation, perceived popularity, perceived image (SI model) Subjective norm *(*Fishbein & Ajzen, 1975), normative belief or motivation to comply, social system, social contexts (DOI), subjective norm, social status of technology use (DUDM); self-expression - *a means of boosting status* (Venkatesh & Davis, 2000)
Perceived Behavioral Control	The control beliefs relating to resource factors such as time and money and IT compatibility issues (Taylor & Todd, 1995).	TPB	UTAUT DTPB MAPS	Facilitating condition - *availability of resources* (UTAUT, DTPB) Self-efficacy -*comfort with using the innovation* (DTPB)
Indispenseability	The extent to which livelihood is dependent on technology- eg. necessities (Shih, Venkatesh, Chen & Kruse, 2013).	DUDM		Technology impact - extent to which a new technology has replaced earlier technologies, altering how things are done (DUDM)
Firm Level				
Technological readiness	Internal and external supporting technologies relevant to the firm and the current innovation, and knowledge required.	PERM	TTF, TOE, PERM Model	Relative advantage, complexity, compatibility (DOI); Technology Readiness, Technology Integration (TOE); Characteristics of the technology (TTF); Organizations' perception, comprehension of e-commerce and its potential benefits (PERM)

Managerial Innovativeness	Attitude toward change characteristics, future orientation, proactiveness, support, and risk behavior.	PERM Model	TOE	Leader- *individual characteristics*, managerial commitment, strategic insight, top management support, risk taking, pursuit of business opportunities (Lumpkin & Dess, 2001).
Strategic fit with operations	Characteristics of the Task to be performed. The extent to which digital technology fits business operations.	TTF	TOE	Scope of operation (TOE); Perceived benefits, technology fit (Goodhue & Thompson, 1995).
Organizational readiness	The scope, size, managerial structure, organizational slack resources, business process, creativity, and openness.	TOE	RBV, Lacovou, Benbasat, and Dexter model	Organizational readiness- *preparedness for future environmental changes* (Lacovou, Benbasat and Dexter model); ICT & Network capability, Strategic Behavior - *defensiveness & proactiveness dimension* (RBV); Internal organizational structural characteristics, centralization, complexity, formalization, interconnectedness (TOE); network density-eg.*"get-help" ties for an employee* & network centrality- *"give-help" ties for an employee* (MAPS)*;* Business processes, organizational resources (PERM)
Industry adoption	The readiness of the industry in which a firm conducts its business—characteristics of industry and market readiness, structure, customers readiness, competitors level of adoption, and dealings with the government.	TOE	DOI, Institutional Theory PERM,	External characteristics of the organization, eg. *Openness* (DOI); Mimetic pressure- *imitating competitors,* Coercive pressure - *forces exerted on organizations by other organizations upon which the organizations depends*, Normative institutional pressure- *dyadic relationships where companies share some information, rules, and norms* (Institutional theory); Market Forces e-Readiness, Support Industries e-Readiness, Government e-Readiness (PERM)
Environmental Level Factors				
Government Championship	The extent of top-level support and promotion by influencing government officials' views of new technologies, and active removal of obstacles (Howell, Shea & Higgins, 2005).	Promoter Theory	Strategic Management	Promoter, Assistance,
Government Policy	Deliberate policies aimed at promoting technology adoption.	CPT		General Commerce policy, technology specific policy, regulatory support (DOI)
Trust	The level of expected reliability for players of technological transactions.	CPT		The overall level of confidence that society have in the institutions of the transactions (such as banks, buyers and sellers, and governmental institutions) in issues of redress of failed transactions.
Risk-taking culture	Predisposition to absorb possible gains or losses resulting from a given action (Morgan & Strong, 2003).	CPT		

Table 2: Construct development for the building of the initial model

Table 2 Continued:
Models names
DOI = Diffusion of Innovations (Rogers 1962); DUDM = Dynamic Use Diffusion Model (Shih, Venkatesh, Chen & Kruse, 2013); ITMA = Integrated Model of Technology Acceptance (Venkatesh et al., 2002); PERM = Perceived E-Readiness Model (Mola & Licker, 2005); CPT Framework = Culture, Policy & Technology Framework (Bajaj & Leonard, 2004); TOE = Technology, Organization & Environment Framework (Tornatzky & Fleischer, 1990); VAM = Value-Based Adoption Model (Dodds & Monroe, 1985); SI Model = Social Influence (Fishbein & Ajzen, 1975; Venkatesh & Brown, 2001); MM = Motivational Model (Venkatesh & Speer, 1999); MT = Motivational Theory; RBV= Resource Based View; TTF = Task–Technology–Fit (Goodhue & Thompson, 1995).

Since the focus of the study is firm level adoption, the personal level factors are being treated as antecedents of firm level adoption because the characteristics and attitude of employees serve as a resource for the firm (RBV). The societal level factors are also treated as facilitators or moderating factors of adoption. These are summarized in the initial conceptual framework in Figure 2.

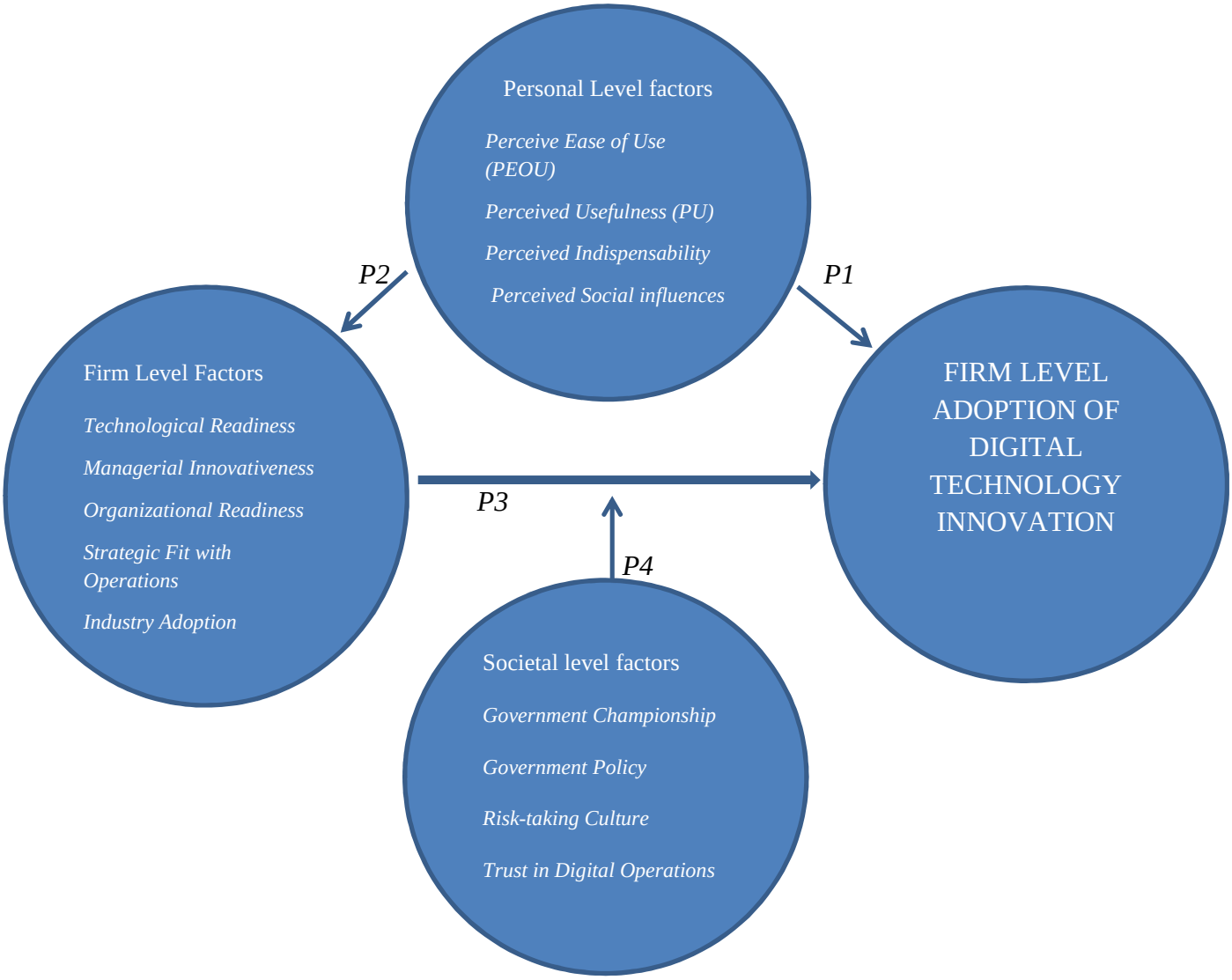


Figure 2: Firm Technology Adoption Model F-TAM for SMEs in a developing country context

3.1. Propositions from the Conceptual Model

This model is expected to work at the organizational level of adoption. The relationships between the individual level factors, firm level factors and societal level factors are described in the set of propositions below. As personal level factors lead to adoption at any level, it directly influences firm

level factors, indirectly leading to firm level adoption. Both individuals and firms exist within a society. Thus, the active promotion of adoption is expected to have a moderating effect on the firm adoption. From this framework the following propositions are being posited for testing.

Personal level factors that have been found to directly lead to adoption include: perceived usefulness (Datta, 2011); perceived ease of use (Kim, Chun & Lee, 2014); perceived social influence (Datta, 2011); and perceived indispensability (Shih, Venkatesh, Chen & Kruse, 2013; Venkatesh, 2008; Hoffman, 2012; Hoffman, Novak & Venkatesh, 2004). These are generally perceptual and attitudinal factors of an individual (Talukder, Harris, & Mapunda, 2008). With these constructs, people will adopt innovation whether they are in a firm setting or not. It is uncommon for a firm to insist that a technology that works well and fits an employee's roles should not be used simply because the firm did not provide authorization for its use. Therefore employees are also likely to use technologies that they personally know will fit well in their job schedules. Thus employees as individuals must adopt the firm innovation to give meaning to firm adoption. If employees are not prone to adopt as individuals, they are also likely not to adopt the innovations as a firm unit. Evidently, the tendency of individuals to adopt an innovation will directly influence the tendency of the firm to adopt the same innovation. Therefore, we define the following:

Proposition 1: *Individual level factors directly lead to firm level adoption of digital innovation.*

The Resource Based View posits that the resources of a firm, including people, assets, technologies, management, processes etc., are at the center of competitiveness. The kind of resources available shapes the ability of the firm to be innovative and adaptive to innovations (Najaftorkaman, Ghapanchi, Talaei-Khoei & Ray, 2015). As employees adopt an innovation, it creates a subjective norm (Fishbein & Ajzen, 1975) within the social system (Rogers, 1962), in this case the firm, therefore causing other employees to adopt the same innovation. As more employees adopt innovations, the organizational readiness, strategic fit as well as managerial support can be realized. For instance, a manager is likely to encourage employees who use private social media to generate customers for the firm as an initial step before creating the firm's social media page. Thus if proposition one holds true, then this suggests that the factors that lead to personal level adoption will directly lead to the availability of firm level factors of adoption, therefore indirectly leading to firm level adoption. Thus, personal level factors of adoption indirectly lead to firm level factors adoption. Therefore, we define the following:

Proposition 2: *Individual level factors of adoption directly influence firm level factors of adoption.*

At the firm level, a firm will adopt an innovation if the technology is likely to ultimately improve returns on investments. However, this intention to adopt is made possible if specific factors are present. These include technological readiness (Boateng, Heeks, Molla & Hinson, 2011; Zhu, Kraemer & Xu, 2006); managerial innovativeness (Boateng et al., 2011); strategic fit with operations (D'Ambra, Wilson & Akter, 2013); organizational readiness (Boateng et al., 2011; Zhu, Kraemer & Xu, 2006) and industry readiness (Boateng et al., 2011; Rogers, 1962). The availability of these factors will hasten or lead to actual adoption of the innovation. The availability of these factors would naturally indicate that the firm is evolving and naturally needs to adopt newer technologies. For instance as an industry becomes ready for a technology, a firms competitors will likely adopt early in order to achieve competitive advantages due to first mover effect. Firms who do not adopt will soon find that they are making less profits, or losing customers, mainly due to obsolete technology. Therefore, we define the following:

Proposition 3*: Firm level factors leads to general adoption.*

Firms exist within a macro environment. Specific actions and inactions within the macro environment directly affect a firm's actions. Specifically related to the adoption of digital innovations, factors that have been found to enhance adoption include government championship (Caerteling, Halman, Song, Dorée, & Van Der Bij, 2013), government policy (Boateng et al., 2011; Rogers, 1962), trust (Boateng et al., 2011), and risk culture (Boateng et al., 2011). These factors directly enhance the adoption. This means in countries where people perceive a security of these factors, people are more encouraged to

adopt as individuals or as business units. For instance, governments' active involvement in diffusion of a technology creates an enabling environment for knowledge, skills, and availability of the innovations. Thus when a firm decides to adopt an innovation, these societal level factors will make it easier for the firm to adopt. Therefore they are expected to moderate the relationship between firm level factors and adoption. There, we define the following:

Proposition 4*: Firm level adoption is moderated by societal level factors.*

4. Discussion and conclusion

In the context of developing countries, and for that matter Ghana, behavioral intention to adopt an innovation such as digital technologies does not necessarily result in adoption. The adoption of mobile technology, however, has defied the normal adoption pattern in the Ghanaian context. The paper shows a categorization of factors that actually lead to adoption, and might help to explain actual adoption of mobile technologies at firm level, into a model. This paper concludes that personal level factors will directly lead to firm level adoption since the employees of the firm are the ones who are expected to adopt and use the innovations in the firm. Thus, their individual innovativeness will directly affect that of the firm. At the firm level, other micro factors tailored to each organization directly affect their adoption behavior. This adoption behavior is influenced or moderated by the general macro environmental factors prevailing in the context of adoption.

This conceptual study sought to develop an initial firm level model of adoption to explain factors that lead to adoption of digital technologies in the developing country context. The outcome is relevant to academics who are interested in studying diffusion of digital innovations by closing the knowledge gap between behavioral intention and actual adoption. The contribution of this paper is an initial step towards an improvement of existing knowledge (Gregor & Hevner, 2013) on adoption of innovations. The result is a prescriptive knowledge (Gregor & Hevner, 2013); that is, a model of factors that relate to actual adoption of digital innovations in a developing country context by SMEs. Thus, the paper improves our understanding of adoption digital innovations in a developing country context (Gregor & Hevner, 2013).

The industrial contribution or managerial implications of this study to industrial practice is twofold. It is expected that the model would provide levers for strategic use in the adoption of digital innovations for increasing revenues and profits among entrepreneurs and SMEs. These factors provide a reference point of factors that must necessarily be built into the organizational environments or lobby for, if they intend to adopt innovations. The outcome is also expected to provide pointers to developing country governments who want to design and build infrastructure, and make deliberate policies, and laws to promote the adoption of other innovations apart from mobile technologies. The outcome will serve as a guide on what to focus on.

5. Limitations and future research

The major limitation of this paper are that it is currently based only on literature. It has not been validated. The model also does not, as yet, capture industry views on adoption. For further studies on this model, there needs to be further evaluation for validity (Hevner, March, Park & Ram, 2004; Venable, Pries-Heje & Baskerville, 2012; Gregor & Hevner, 2013). To further strengthen this model for the context of its development, there needs to be a qualitative exploratory study on industry practitioners. The opinions of various academics on innovations and technology also need to be captured. This needs be a triangulation of methods, in order to further validate or strengthen this initial model. For final validation of the model, this paper suggests a cross sectional survey of the revised conceptual model on SMEs with a large sample size using a stratified form of sampling. It is expected that the model will become more robust in the Ghanaian context.

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