Towards a Dynamic Model for the Diffusion of Learning Management Systems by University Instructors

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Abstract

Among the numerous diffusion studies conducted in recent years, the survey of Learning Management System (LMS) use in Africa conducted in 2008 by United Nations, Educational, Scientific and Cultural Organization (UNESCO), highlighted the rather low use of formal Learning Management Systems (LMSs) in universities, colleges and schools across much of the African continent. Consequently, since the problem of technology rejection and underutilization is common, the purpose of this study was to empirically test a dynamic, more complete, and parsimonious technology acceptance model (DTAM) that that institutions of higher education can use in the deployment of LMS to increase the adoption and diffusion of these technologies by university instructors for teaching and learning.The study used a cross-sectional survey questionnaire distributed to a sample of 109 university instructors distributed in 16 universities in Kenya, with a response rate of 72.8 percent. The result showed that **perceived resources**, availability of ICTs, **university leadership, perceived ease of use (PEOU), ,** and **LMS relevance** are among the top five dominant characteristics that significantly and directly impacted instructors' intention to use and actual usage of LMS. DTAM was empirically proved to be stable by a number model statistical indices including Normed Chi-Square= 1.073, GFI=0.908, RMSEA=0.026,, IFI=0.963, TLI=0.948, and CFI=0.95.4.The geographical, and technological limitations of research in this paper are acknowledged. This paper contributes to both information systems research and practice by giving valuable insights from research to help institutional administrators and vendor successfully deploy LMS and improve its acceptance and utilization. This paper addresses the omission of dynamism and environmental factors in TAM. It is also a response to the urgent call to find a suitable theoretically founded replacement to TAM. The paper provides researchers with a promising starting point for establishing a more dynamic, complete and parsimonious diffusion model to explain technology acceptance.

Keywords: LMS, Diffusion, Dynamic, TAM, DTAM, Model, e-Learning

INTRODUCTION

Definition. Learning Management Systems (LMS)
Learning Management System (LMS) is viewed differently among different players depending on how many features and tools are opted to be incorporated. Here, we provide a background of LMS including its definition, features, tools, benefits and applications. A Learning Management System (LMS) or Virtual Learning Environment (VLE) can be defined as a software application or web-based technology that is used to plan, deliver or access a particular learning process, which is usually referred as electronic learning systems (Nanayakkara, 2005). This study defines the dynamism of a model as the capability of the model to take on any number of variables that matter today or those that will matter in the future, and in any region/organization of the earth and for any technological innovation.

EXISTING WORK

In recent years, the diffusion process of e-learning has been at the centre of several studies. However, these studies focused on the USA case, where there has been an exponential adoption both in the private and public sectors (Yun & Murad, 2006:2135). While preceding studies like TAM (Davis, Bagozzi, & Warshaw, 1989) presented a *parsimonious* model, and others like TAM3 (Venkatesh & Bala, 2008) aimed at completeness, their major weaknesses are the lack of dynamism that limited their applicability to both developed and developing worlds. In addition, another shortcoming of previous theorization of TAM has been their assumption that Perceived Usefulness and Perceived Ease Of Use are the only key determinants of Behavioural Intention. Due to these limitations, a growing number of researchers have advocated for extension of the TAM theoretical framework (Bagchi & Udo, 2010, Schwarz & Chin, 2007). To address this gap, this study has presented a dynamic TAM that adds richness and insights to our understanding of user reactions to new ICTs in general and the higher education context in particular (Al-senaidi, Lin, & Poirot, 2009). Building on a number of theories and institutional literature, the study analyses the antecedents of the LMS diffusion and infusion process in higher education. In addition the study propose a dynamic technology acceptance theoretical framework.

Gaps Addressed

Although in the past two decades the Technology Acceptance Model (TAM) has effectively catalyzed a great number of studies related to information and communication technology (ICT) intentions to use or its actual usage, there has been a recent build up of criticism of TAM by researchers (Schwarz & Chin, 2007). Schwarz & Chin argue that the focus of previous TAM studies has been on a narrow aspect of usage usually, degree or frequency of use. Moreover, the researchers have questioned the simple notion that ICT acceptance be construed as the relationship between antecedent factors such as perceived ease of use and perceived usefulness to foretell the particular type of intention connected to amount of ICT usage (Schwarz & Chin, 2007). In addition, the study by Chuttur (2009) concluded that "research in TAM lacks sufficient rigor and relevance that would make it a well established theory for the IS community". In brief, the criticism for the TAM model can be classified into three types, namely the methodology used to test the TAM, the variables and relationships that exist with the TAM model, and the core theoretical foundation underlying the TAM (Chuttur, 2009). Some of the erroneous methods used has been for example the assumption that "determinants of Perceived Ease Of Use will not influence Perceived Usefulness" (Venkatesh & Bala, 2008:281). This paper adds insights into these gaps that require knowledge.

TRAJECTORY

This paper starts by agreeing with Venkatesh, Davis, and Morris, (2007) that the answer to the question "Is technology acceptance research dead?" is "yes" if the inquiry implies a continuation of replications of TAM with no substantive theoretical advance. However, the "no" part of the answer by Venkatesh et al. is adopted by this paper by making a typical response that stems from the remarkable opportunities that are still available to make substantial theoretical advances using the current TAM knowledge as the starting point. In this paper, we take the opportunities for future advances on technology diffusion and propose a dynamic TAM (DTAM) theoretical framework. The rest of the paper presents, literature review, Theoretical framework, research methods, findings, discussion, conclusion and future research directions.

2. LITERATURE REVIEW

2.1 Demand for Flexible Learning and Teaching

Minishi-Majanja (2007:5) established that in the higher education and human capacity building sector, ICTs are impetus for change from the traditional concepts of teaching and learning, as well as prime motivation behind the change in scholarly and professional activities. This underscores the importance of ICTs like LMS in higher education in achieving the goal of providing flexible teaching/learning environment.

In the context of higher education, this goal is concerned with the provision of a learning environment for learners that incorporates a variety of access opportunities and learning resources such as online education, distance education, blended learning and computer-assisted education (Minishi-Majanja, 2007:8, Kwache, 2007:395). This change has resulted in students and instructors in higher education institutions being increasingly exposed to information communication technology (ICT) dependent learning environments containing interactive learning activities which are supported with text, data, audio, video, still images and animations. Consequently, an acute need to determine how well these sorts of ICTs are adopted by instructors and diffused and infused to their teaching and learning activities has been recently recognized by researchers (Shea, Pickett, & Li, 2005, Siragusa & Dixon 2009:969). This study was therefore a timely action to address this need in higher education.

Studies on Technology Adoption, Diffusion and Infusion

The diffusion of information technology has been defined as a collective process involving introduction, assimilation, and permeation of information systems technology throughout an organization (Odero-Musakali & Mutula, 2007). Diffusion will therefore, refer to the introduction or adoption of novel technology and its eventual integration into the individual daily activities such as studies or work. The innovation under consideration is ICTs - Internet/World Wide Web, e-mail, and Learning Management System (LMS). Unlike other researchers, we will approach the diffusion issue from the individual innovation perspective. Yousafza *et al.* (2006:20) has proposed a number of external variables that affect internal belief namely, Perceived Usefulness (PU) and Perscieved Ease Of Use (PEOU). A list of 139 possible factors for use in a TAM model are established in the sudy by Jeyaraj *et al.* (2006:6).

These factors can be categorized into four subsets namely environmental, technological, organizational, and individual factors. The involvement of these four categories of factors and their interactions in the theorized Dynamic Technology Acceptance Model (DTAM) is shown in Figure 1 allows any researcher to select a sizeable and suitable set of external variables from each of the four categories of factors and plug them into the Dynamic TAM for investigation on the particular context and ICT system.

Theories on Technology Acceptance

Similar to the agenda of this paper, previous researchers in the area of Information Systems and Information and Communication Technology have been concerned with researching the theories and models that will have power in predicting and explaining behaviour across different fields.

The main objectives of these studies have been to find ways of promoting use, and to examine what thwarts intention to use the technology. Each important technology acceptance theory or model, which has not been outdated by recent research, has different premises and benefits. Consequently, this paper has used triangulation method and picked beneficial insights from preceding ten theories to build the dynamic TAM. These theories include:

(1). Theory of Reasoned Action (TRA),
(2). Innovation Diffusion Theory (IDT),
(3). Theory of Planned Behaviour(TPB),
(4). Social Cognitive Theory,
(5). Decomposed Theory of Planned Behaviour (DTPB),
(6). Technology Acceptance Model (TAM),
(7). Technology Acceptance Model 2(TAM2),
(8). Combined TAM and TPB(C-TAM-TPB),
(9). The Unified Theory of Acceptance and Use of Technology (UTAUT), and
(10). Technology Acceptance Model (TAM 3)

THEORETICAL FRAMEWORK

In previous studies, several theories and models have been proposed to address the technology acceptance/rejection problem over the decades. However, several studies have argued that TAM is imperfect (King and He, 2006). To address some of TAM shortcomings, several recent studies have proposed extension of TAM (Venkatesh and Bala, 2008; Nanayakkara, 2005; Sheng, Jue, and Weiwei, 2008) while others have called for its complete replacement (Schwarz & Chin, 2007) . This study follows that line of investigation to further provide additional understanding of technology diffusion.

Figure 1 is the overview of the DTAM research model adopted for this study. In the model, the TAM variables are indicated, while the arrows in the figure indicate the directions of the key hypotheses. First, the research model proposes that four sets of external variables namely: environmental, technological, organizational, and individual factors will influence both Perceived Usefulness and Perceived Ease Of Use. Second, in the TAM, the relationships between the constructs of Perceived Usefulness, Perceived Ease Of Use and Behavioural Intention are indicated. *Behavioural Intention is* defined as "a person's subjective probability that he/she will perform some behaviour" (Fishbein & Ajzen, 1975:288).

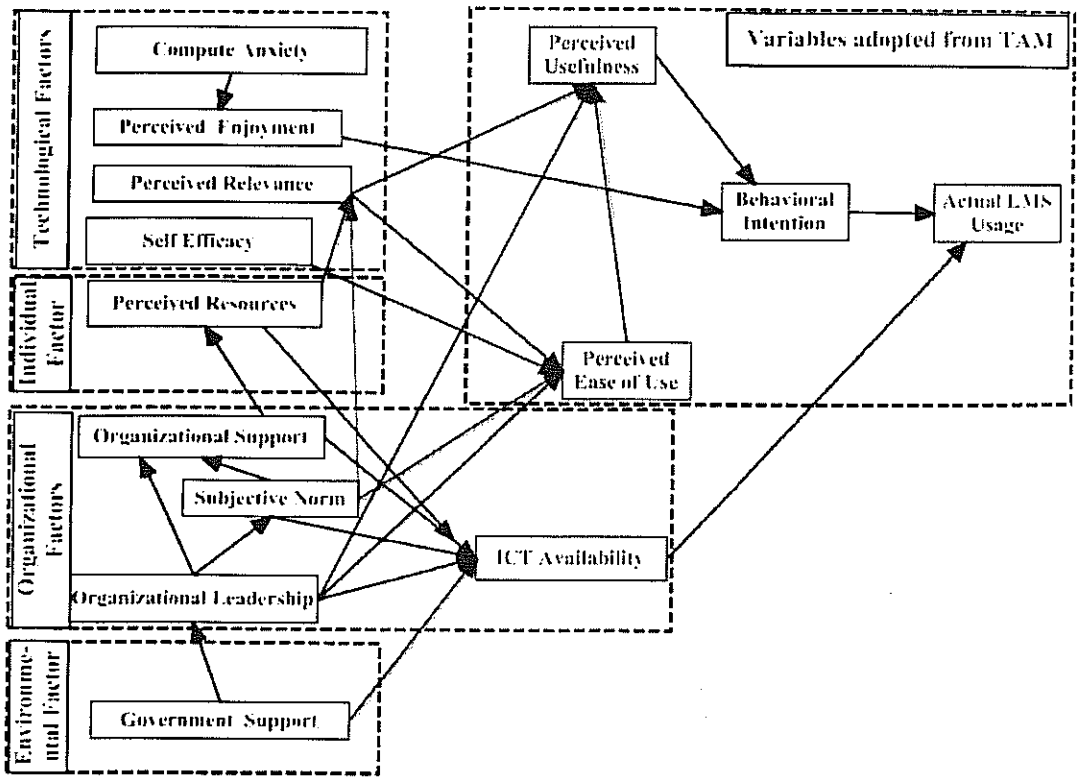


Fig 1. Theoretical Research Model (Dynamic Technology Acceptance Model) (DTAM)

Considering the higher education sector in developing countries, the omission by preceding studies of external variables such as Perceived resources, Organizational leadership, Access to ICTs, and Availability of ICTs as well as environmental factors in preceding studies such as that of Cheung and Huang (2005), makes their frameworks inadequate for developing countries context where these factors are major issues of concern. It is our opinion that in such contexts, the inclusion of environmental factors in the external factors is more appropriate as proposed in the Dynamic TAM. Figure 2 is a schematic diagram showing the general influence by the external factors to the individual in the process of ICT adoption, diffusion and infusion.

The focus of contemporary ICT adoption and diffusion research appears to be centred on understanding the dynamics of adoption and diffusion at four specific levels: national, industry, organizational and individual (Binney, 2007:101). In this study, national and industry factors are termed as environmental factors. These variables are beyond the control of both the individual and the organization, yet may influence the adoption and diffusion behaviours of the individual student. This is illustrated in Figure 2.

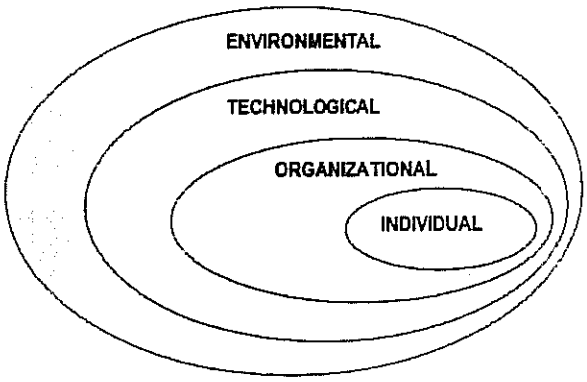


Fig 2. Factors that Influence Individual ICTs Adoption and Diffusion
(Source: Macharia & Nyakwende, 2009:3).

This study examined the relationships among perceptions of usefulness, ease of use, intention to use LMS, and external variables namely environmental, individual, technological, and organizational factors and their effect on Behavioural Intention to use ICT. To achieve this goal, the following hypotheses were formulated to investigate ICT diffusion and infusion in institutions of higher learning:

H1. Environmental factors significantly influence the diffusion and infusion of LMS in higher education.
H2. Technological factors significantly influence the diffusion and infusion of LMS in higher education.
H3. Organizational factors significantly influence the diffusion and infusion of LMS in higher education.
H4. Individual factors significantly influence the diffusion and infusion of LMS in higher education.
H5. The TAM cannot adequately be used as a model in explaining the diffusion and infusion of LMS in higher education institutions.

RESEARCH METHODOLOGY

This design used a cross-sectional approach taking on a survey method that used a self-administered questionnaire *distributed to a sample of 109 university instructors, with a response rate of 72.8 percent* for data collection. In addition, discussion on the instrument constructs was done with a panel of experts to improve its validity and reliability; and *triangulation of theories*, where ten theories were taken from various disciplines and used to explain the ICT diffusion and infusion phenomenon in higher education (Mangan, 2004:568). Rather than use a random sampling approach, a purposive sampling technique was applied to select the participating schools/departments within a university in the sample that use ICTs in the running of their academic programs. The SPSS 18.0 and AMOS 7.0 with multiple indicator structural equation analyses were used to analyze both the measurement model and the structural model.

FINDINGS

Instrument Reliability

The results in Table 1 shows that the reliabilities of majority of the study constructs had a factor loading above 0.7 and that the Cronbach's Alpha reliability was higher than 0.8 for most of the constructs, which represents an acceptable level of reliability for this study. In addition to item loadings and Cronbach's Alpha reliability, the measurement model was further assessed in terms of convergent and discriminant validity that follows in succeeding sections.

Content Validity

According to Grandy (1992) it is important to avoid subjectivity on content validity that is usually attributed to researchers' subjective judgment, and not from empirical error. Consequently in this study, content validity was achieved and justified by examining how the scales were derived and validated in preceding research. Generally, the TAM constructs have been validated by Davis (1989) and Davis et al. (1989) and other researchers. They are therefore found to be robust in subsequent studies (Venkatesh and Bala, 2008). Additionally, organizational variable constructs have been supported and validated by several successive researchers (Hung, Chang, and Lee, 2001).

Table 1 Factor Loadings and Cronbach's Alpha

Variable	Variable Code	Loadings	Chronbach's Alpha
Perceived Recourses (PR)	PRHS01	0.733	
	PRHS02	0.862	
	PRHS03	0.845	
	DOC04	0.854	0.925
	DOC05	0.827	
	DOC06	0.736	
	TIME08	0.562	
	TIME09	0.485	
Organizational Leadership (OL)	CEO02	0.602	
	CEO03	0.665	
	OR04	0.749	
	OR05	0.793	0.927
	OR06	0.762	
	TMGT08	0.805	
	TMGT09	0.803	
	TMGT10	0.808	
Actual ICT usage (AU)	AET02	0.708	
	AET04	0.829	
	AET05	0.679	
	EXPICT01	0.821	
	EXPICT03	0.763	
	EXPICT04	0.834	
	EXPICT05	0.69	0.908
	EXPICT06	0.64	
Behaviural Intention to Use (BIU)	BIU01	0.584	
	BIU02	0.689	
	BIU03	0.718	
	BIU04	0.784	0.901
	BIU05	0.811	
	BIU06	0.736	
Perceived Ease of Use (PEOU)	PEOULMS09	0.849	
	PEOULMS11	0.862	0.933
	PEOULMS12	0.821	

Variable	Variable Code	Loadings	Chronbach's Alpha
Subjective Norm (SN)	SNLMS09	0.811	
	SNLMS10	0.895	
	SNLMS11	0.869	0.944
	SNLMS12	0.87	
Organizational Support (OS)	OSLMS09	0.694	
	OSLMS10	0.704	
	OSLMS11	0.74	0.922
	OSLMS12	0.685	
Computer Anxiety (CA)	CA02	0.824	0.873
	CS03	0.851	
	CS04	0.811	
Perceived Usefulness (PU)	PULMS09	0.716	0.556
	PULMS10	0.736	
	PULMS11	0.703	
	PULMS12	0.544	
Relevance (REL)	RLMS07	0.667	0.891
	RLMS08	0.76	
	RLMS09	0.741	
Perceived enjoyment (PE)	PE01	0.691	0.851
	PE02	0.581	
	PE03	0.794	
Voluntariness (VOL)	VLMS07	0.832	0.742
	VLMS08	0.727	
	VLMS09	0.837	
Government Support (GS)	ECGS06	0.725	0.699
	ECGS07	0.765	
	ECGS08	0.565	
Self Efficacy (SE)	CSE03	0.93	0.907
	CSE04	0.907	
ICT Availability	AVAIL02	0.692	0.877
	AVAIL03	0.554	

- Extraction Method: Principal Component Analysis.
- Rotation Method: Varimax with Kaiser Normalization. Overnment Support
- Rotation converged in 14 iterations.

Convergent validity

Convergent validity measurement can be achieved by assessing three aspects namely: construct reliability, item reliability, and average variance extracted (AVE) (Bagozzi, 1981). For brevity, this paper used the average variance extracted (AVE) value\, which is an evaluation of the amount of variance shared by in-group items captured by the underlying construct in relation to the amount of variance due to measurement error. This measurement was computed as follows: *(sum of squared factor loadings)/{(sum of squared factor loadings) + (sum of error variances)}* (Bagozzi, 1981).It is required that to conclude convergent validity the value of AVE should be higher than 0.50.. From the results shown in Table 2 all AVEs results except one out of ten constructs in this research have AVE values greater than the required threshold of 0.50.

Table 2 Convergent Reliability

Construct	Average Variance Extracted (AVE)
Perceived Recourses (PR)	0.7534
Organizational Leadership (OL)	0.725
Actual ICT usage (AU)	0.7352
Behaviural Intention to Use (BIU)	0.7002
Perceived Ease of Use (PEOU)	0.6993
Subjective Norm (SN)	0.7913
Organizational Support (OS)	0.7309
Computer Anxiety (CA)	0.8208
Perceived Usefulness (PU)	0.763
Relevance (REL)	0.7601
Perceived enjoyment (PE)	0.7492
Voluntariness (VOL)	0.7844
Government Support (GS)	0.7562
Self Efficacy (SE)	0.8573
ICT Availability	0.7422

The results displayed in Table 1 makes it possible to conclude that the instrument used in this study demonstrates sufficient convergent validity. The AVE results shown in Table 3 of the study constructs are all greater than 0.50 except one, indicating that variance due to the construct is greater than the variance due to measurement error for all research constructs.

Discriminant Validity

In this study, the discriminant validity, was established by requiring that the average variance extracted (AVE) should be greater than 0.50 and the value of every AVE in the AVE analysis should be much larger than any square of correlations among any pair of latent constructs. The results of Table 3 shows that the AVEs of all the variables are above the acceptable level (>0.5) (Gallego, Luna, and Bueno, 2008).

Table 3 Discriminant Validity–Comparing AVEs and Squared Correlations

	PR	OL	AU	BIU	PEOU	SN	OS	CA	PU	REL	PE	VOL	GS	CSE	AVAIL
AVE	**0.75**	**0.72**	**0.74**	**0.70**	**0.70**	**0.79**	**0.73**	**0.82**	**0.76**	**0.76**	**0.75**	**0.78**	**0.76**	**0.86**	0.74
PR	1.00														
OL	0.36	1.00													
	(0.13)														
AU	0.41	0.23	1.00												
	(0.16)	**(0.05)**													
BIU	0.29	0.40	0.42	1.00											
	(0.08)	**(0.16)**	**(0.18)**												
PEOU	0.19	0.32	0.26	0.16	1.00										
	(0.03)	**(0.10)**	**(0.07)**	**(0.03)**											
SN	0.25	0.32	0.40	0.24	0.40	1.00									
	(0.06)	**(0.10)**	**(0.16)**	**(0.06)**	**(0.16)**										
OS	0.54	0.58	0.25	0.27	0.26	0.42	1.00								
	(0.29)	**(0.34)**	**(0.06)**	**(0.08)**	**(0.07)**	**(0.18)**									
CA	0.21	0.01	-0.01	-0.12	0.07	0.07	0.02	1.00							
	(0.05)	**(0.00)**	**(0.00)**	**(0.02)**	**(0.01)**	**(0.00)**	**(0.00)**								
PU	0.18	0.15	0.35	0.19	0.40	0.27	0.14	0.21	1.00						
	(0.03)	**(0.02)**	**(0.12)**	**(0.03)**	**(0.16)**	**(0.07)**	**(0.02)**	**(0.04)**							
REL	0.32	0.38	0.43	0.41	0.39	0.40	0.24	-0.08	0.37	1.00					
	(0.10)	**(0.14)**	**(0.18)**	**(0.17)**	**(0.16)**	**(0.16)**	**(0.06)**	**(0.01)**	**(0.14)**						
PE	0.22	0.28	0.23	0.46	0.13	0.07	0.16	-0.44	0.03	0.25	1.00				
	(0.05)	**(0.08)**	**(0.05)**	**(0.21)**	**(0.02)**	**(0.00)**	**(0.02)**	**(0.19)**	**(0.00)**	**(0.06)**					
VOL	0.09	0.03	0.12	0.01	0.15	0.06	0.02	0.12	-0.02	0.02	0.04	1.00			
	(0.01)	**(0.00)**	**(0.01)**	**(0.00)**	**(0.02)**	**(0.00)**	**(0.00)**	**(0.01)**	**(0.00)**	**(0.00)**	**(0.00)**				
GS	0.15	0.43	0.12	0.20	0.18	0.19	0.24	0.10	0.26	0.20	0.14	0.03	1.00		
	(0.02)	**(0.18)**	**(0.01)**	**(0.04)**	**(0.03)**	**(0.04)**	**(0.06)**	**(0.01)**	**(0.07)**	**(0.04)**	**(0.02)**	**(0.00)**			
CSE	-0.05	0.12	-0.02	0.02	0.16	-0.03	-0.11	0.02	0.14	0.15	0.10	0.12	0.21	1.00	
	(0.00)	**(0.01)**	**(0.00)**	**(0.00)**	**(0.03)**	**(0.00)**	**(0.01)**	**(0.00)**	**(0.02)**	**(0.02)**	**(0.01)**	**(0.01)**	**(0.04)**		
AVAIL	0.57	0.42	0.42	0.19	0.17	0.43	0.52	0.02	0.17	0.31	0.14	-0.10	0.22	0.11	1.00
	(0.32)	**(0.18)**	**(0.17)**	**(0.04)**	**(0.03)**	**(0.19)**	**(0.27)**	**(0.00)**	**(0.03)**	**(0.10)**	**(0.02)**	**(0.01)**	**(0.05)**	**(0.01)**	

Note: The values in the brackets represent the squared correlation values between constructs of the respective row and column

The structural model

Table 4 presents the results of the analysis of the structural model. Twenty of the twenty five associations between variables investigated in the structural model have significant outcome.

Table 4 Significance of the Individual Paths in Regression Generalized Least Squares Estimates Weights: (Default model)

			Estimate	S.E.	C.R.	P	Label
OL	<---	GS	.295	.078	3.791	***	par_5
SN	<---	OL	.549	.154	3.559	***	par_7
OS	<---	OL	.765	.137	5.586	***	par_9
OS	<---	SN	.264	.084	3.141	.002	par_11
PR	<---	OS	.422	.074	5.715	***	par_3
REL	<---	SN	.317	.083	3.832	***	par_12
REL	<---	PR	.243	.105	2.308	.021	par_14
AVAIL	<---	OL	.142	.146	.973	.330	par_15
AVAIL	<---	SN	.272	.081	3.360	***	par_16
AVAIL	<---	PR	.578	.109	5.321	***	par_17
AVAIL	<---	OS	.120	.103	1.165	.244	par_18
PEOU	<---	SN	.305	.092	3.317	***	par_10
PEOU	<---	CSE	.130	.091	1.430	.153	par_13
PEOU	<---	AVAIL	-.085	.086	-.980	.327	par_19
PEOU	<---	REL	.207	.101	2.058	.040	par_20
PE	<---	CA	-.466	.074	-6.274	***	par_23
PU	<---	PEOU	.429	.137	3.140	.002	par_2
BIU	<---	OL	.263	.102	2.586	.010	par_8
BIU	<---	REL	.215	.074	2.925	.003	par_21
PU	<---	REL	.456	.139	3.281	.001	par_22
BIU	<---	PE	.280	.072	3.869	***	par_24
AU	<---	BIU	.458	.146	3.137	.002	par_1
AU	<---	AVAIL	.439	.102	4.305	***	par_4
AU	<---	PU	.280	.081	3.439	***	par_6

Note: *** means p<0.001
From the results shown in Table 4 generated using AMOS 7 structural equation modelling, it is evident that looking at the regression weights and the significant levels (p) we obtain the following equations:

BIU=0.280 **PE** + 0.263 **OL** + 0.215 **REL** + C_1

AU=0.458 **BIU** + 0.439 **AVAIL** + 0.280 **PU** + C_2

PEOU=.305 **SN** + 0.207 **REL** + C_3

PU=0.458 **BIU** + 0.439 **AVAIL** + 0.280 **PU** + C_4

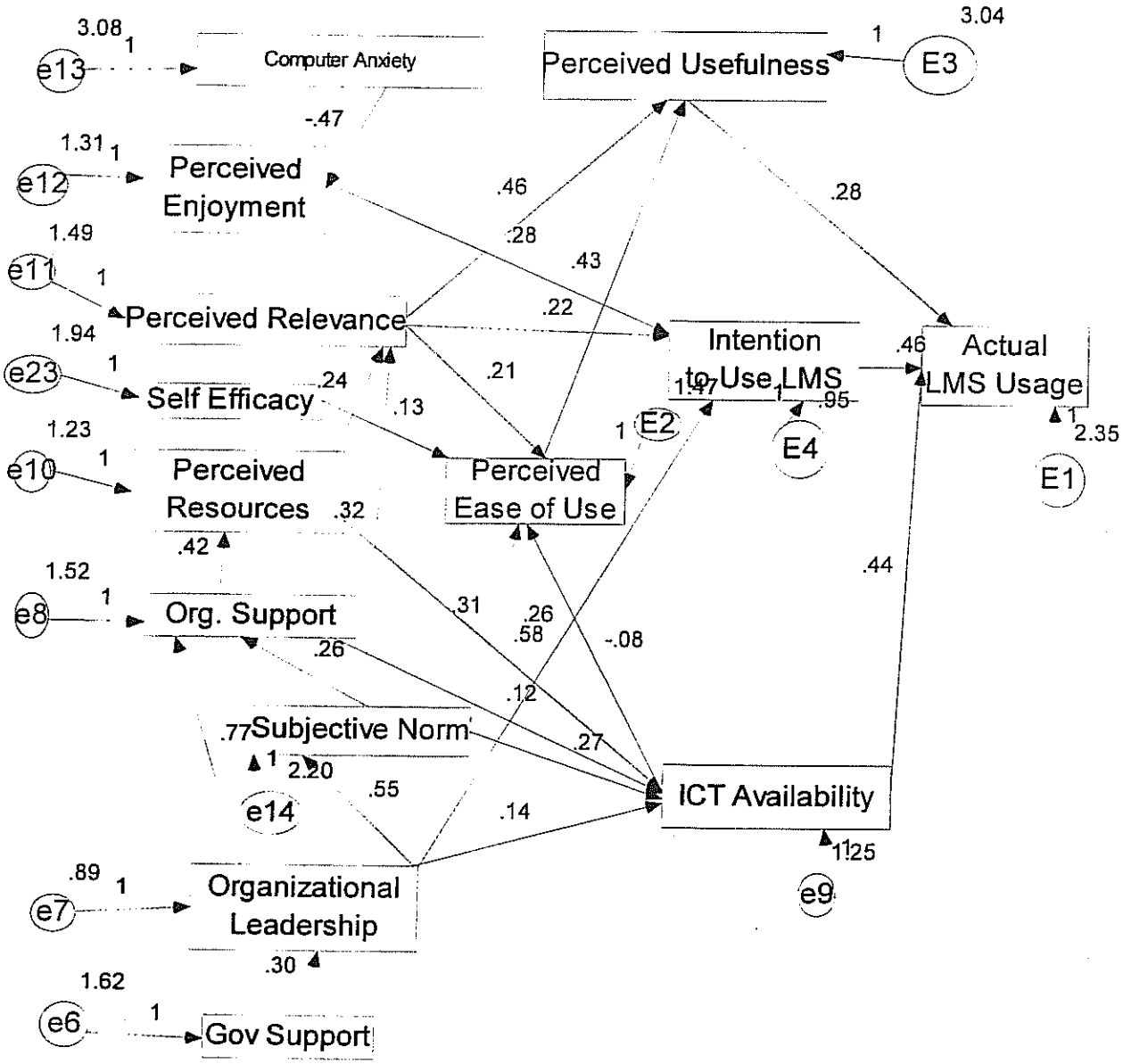
PE=.429 **PEOU** + 0.456 **REL** + C_5

AVAIL=0. 578 **PR** + 0. .272 **SN** + C_6

OS=0. .765 **PR** + 0. .264 **SN** + C_7

OL=295 **GS** + C_8

Where C_1, C_2, C_3, C_4, C_5, C_6, C_7 and C_8



Chi-square=71.909 (67 df), CMIN/DF=(71.909 / 67), p=.319,
GFI=.908, IFI=.963, TLI=.938, CFI=.954, RMSEA=.026, PCLOSE=.831

Fig 3 - Measurement Dynamic Technology Acceptance Model (DTAM) Results

Model Evaluation Using Goodness-of-Fit Indices

Several researchers have pointed out that while fit indices are a useful guide for structural model evaluation, its examination should also be with respect to substantive theory. When model fit is allowed to drive the research process, there is danger of moving away from the original purpose of theory-testing of structural equation modelling. The other weakness with fit indices is the fact they may indicate to a well-fitting model, yet in the real sense, elements of the model may fit poorly (Hooper *et al.* 2008:53). Table 5 presents the model fit indices.

Table 5. Fit Indices of the Dynamic Technology Acceptance Model (DTAM)

Model Fit Measures	Cut Off	Model Values	Fit Measures' Indications	Interpretation
Absolute Fit measures				
Normed x^2 $=X^2/df$	3.0	1.073	<1 1 - 53 >3	Over fit Good fit Over fit
Root Mean Square Error of Approximation **(RMSEA)**	0.8	0.026	0.0 <= about 0.05 <= about 0.08 > 0.1.	exact fit close fit reasonable Over fit
Incremental Fit measures				
Goodness of Fit Index **(GFI)**	>0.90	0.908	0 -1, close to 1 >1	Fit Perfect fit. upper bound 1
Adjusted goodness of Fit Index **(AGFI)**	.>0.90	0.856	<1 1 >1	very good fit Perfect fit. over fit
Parsimony				
Parsimony goodness of Fit Index **(PGFI)**		0.580	0- 1, close to 1 > 1	Fit Very good fit. over fit
Incremental Fit Index *(IFI)*		0.963	0- 1, close to 1 > 1	Fit Very good fit. over fit
Tucker-Lewis coefficient(TLI)		0.938	0- 1, close to 1 > 1	Fit Very good fit. over fit
Comparative Fit Index *(CFI)*		0.954	0-1 1	Fit Very good fit.

Based on several researchers guidelines (Barrett, 2007:815, Marsh et al, 2004:326), in the evaluation of the research model of this study we have selected a few suitable indices as recommended by Arbuckle, (2006: 535) and Hooper *et al.* (2008:53). These include Normed Chi-Square =1.073, GFI=0.908, RMSEA=0.026, FIFI=0.963, TLI=0.938, CFI=0.954 and one parsimony fit index such as the PGFI=0.580. These indices have been chosen over other indices study since they have been recommended by other researchers, as they have been found to be the most insensitive to sample size, model misspecification and parameter estimates

DISCUSSION

The results of Table 4 shows that Availability of ICTs (AVAIL)- ß = 0.439, p<0.001, Behavioural Intention (BIU)- (ß = 0.458, p<0.05, and Perceived Usefulness (PU) - ß = 0. 0280, p<0.001 have a strong direct significant effect on actual usage of LMS (AU).

This result underpins the importance of availability of ICTs, and LMS usefulness in order to diffuse a learning management system effectively in universities. In addition, LMS enjoyment (PE), Organizational leadership (OL) and LMs relevance (REL) have the strongest interaction with the behavioural intention to use LMS by instructors (BIU)..The three constructs PE, OL, and REL have significant direct impact on BIU. The PEOU findings differ with studies using subjects from developed countries that frequently show that the direct effect between PEOU and BUI is significant (Venkatesh and Bala, 2008). The results of PEOU influence on BIU being not significant agree with the finding of (Teo, Lim, and Lai, 1999; Saadé, Nebebe, and Tan, 2007). The findings of this study demonstrate that the foundation formulation of the traditional TAM may not be universal. This is because of the emergence of availability of ICT and organizational leadership, perceived resources as dominant factors in ICT diffusion in addition to the commonly used variables PU and PEOU.

The variance explained by the DTAM predictors is 80%, higher than the usual amount of variance explained by TAM in prior information systems studies which is usually around 50% (Venkatesh and Davis, 1996).

CONCLUSIONS

This study presents significant progress towards showing that it is essential to include environmental, technological, individual, and organization factors in technology acceptance theoretical frameworks as well as in implementation practice of learning management systems in institutions of higher education. This finding makes us conclude that our hypothesis H1: Environmental factors influence LMS diffusion, H2: Technological factors influence LMS diffusion has been empirically proved. H3: Individual factors influence LMS diffusion H4: organizational factors influence LMS diffusion, and **H5.** The TAM cannot adequately be used as a model in explaining the diffusion and infusion of LMS in higher education institutions have been empirically proved. DTAM has been shown to be stable by its model statistical indices. Accordingly, we can conclude that a successful learning management systems deployment should integrate the variables from the four clusters: environmental, technological, individual and organizational as well as allow for maximum dynamism.

DIRECTIONS FOR FURTHER RESEARCH

With regard to future research, more comprehensive models that are invariant with time, place and system, can be used to increase the understanding of the importance of environmental, technological, organizational, individual, and moderating factors in the successful adoption, diffusion and infusion of ICTs in both developed and developing economies are needed. Future studies can use more environmental factors such as vendor support, competition pressure and socio-economic factors. Similarly, researchers can and more individual and moderating factors such as age, gender, and ICT experience, additionally to overcome the geographical limitation, Further research could be carried out using more universities distributed in many countries and continents. In addition the model can be tested using technological artifacts other than learning management systems.

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