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The Role of IT Infrastructure in IS Success Model: Applying the IS Success Model in Low-Income Countries Context

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ABSTRACT

DeLone and McLean's Information Systems Success model was validated empirically in many developed countries. However, it was not tested in Low-Income Countries (LICs) context where IT infrastructure is a serious hurdle for IS success. Testing the Model in LIC context assures generalizability and relevance of the model. This study looks at two research questions: (1) is the IS success model valid in LICs context? and (2) what is the impact of IT Infrastructure on IS success? To address these questions a banking information system at a large bank in Ethiopia is selected as case. The research strategy followed is field study using survey technique. Questionnaire items from prior studies are adapted, but validation of the instrument is in progress. This research-in-progress laid the theoretical background to begin data collection. The preliminary results of the study are expected to be completed and presented on the conference.

Keywords

IS success, low-income countries, Ethiopia, IT Infrastructure.

INTRODUCTION

Today companies are expected to anticipate and react to the growing demands for marketplace (Nah and Lau, 2001). To meet these requirements, companies prepare strategies (Pearlson and Saunders, 2003), strategies that make aggressive and efficient use of Information Technology (IT) as their central issue (Nah and Lau, 2001). Consequently, organizations introduced Information Systems (IS) in their business (Sharma and Yetton, 2003). Unfortunately, significant number of IS implemented are either underused or rejected by users (Sharma and Yetton, 2003).

Even if IT investments are motivated by the potential it gives organizations added benefits and competitive advantages (Bacon, 1992; Lederer and Mendelow, 1988), there were lack of theoretical insight as to what brings IS success. To fill this gap, DeLone and McLane (1992) developed IS success model to identify factors that facilitate or impede successful use of IS in organizations. However, the extent to which this model can be generalized in the context of LICs is not yet well explored.

Many LIC have contexts that are quite different from their peers in developed countries. Constraints of resource: trained labor, capital and facilities (UNDP, 2011); lack of adequate infrastructure: electricity, telecommunication and Internet (IFIP, 2007); and lack of conducive working climate: legal infrastructure, rule of law and stable political system, prevail in most of LICs. Thus, generalizing from the findings of the tests made in developed countries to LICs may result wrong reading and implement ill-equipped solutions. Consequently, using the model in LICs context, to accomplish success and thereby show the positive outcome of IT can be challenged. As a result, governments and organizations in LICs may not be motivated to invest on IS as they may not see the return of the investment.

In many LICs, IT is argued to facilitate development (Ngwenyama and Morawczynski, 2009). One of the LICs that have recognized IT as facilitator of development is Ethiopia (Ethiopian ICT Development Agency (EICTDA), 2006). Ethiopia (Kiyota, Peitsch, and Stern, 2008) and many other LICs have liberalized many economic sectors recently (Cho and Khatkhate, 1989; Prasad, 1997) with the expectation that there would be economic progress. One of these sectors is the banking sector (Kiyota et al., 2008). The government of Ethiopia recognized the critical role of the banking sector, and set a strategy to modernize it using IT and IS to benefit utmost from the sector (EICTDA, 2006; National Bank of Ethiopia (NBE), 2009).

Although the government has such interest, many banks have reservation on IS investment. Indjikian and Siegel (2005) stated that lack of confidence on investment return and lack of knowledge of IS best-use practice caused reservation in LICs. Thus, identifying IS success factors that would help bring benefits to organizations and thereby motivate more investment on IT is essential for managers of organizations.

In the context where there is negative attitude towards investment on IT, there are some political leaders like the Prime Minister of Ethiopia, Meles Zenawi, who believe that IT can leverage efforts of fighting poverty (IRIN, 2005). However, there is a clear gap as to how to measure and prove success of IS use in these countries. In this regard, DeLone and McLane IS success model would have contributed and filled the gap had the applicability and power of explanation of the model is proven in the contexts of LICs.

Although the IS success model was tested in different contexts, such as:- financial sector of Kuwait (Almutairi and Subramanian, 2005), e-procurement in Australia (Vaidya, 2007), e-commerce in USA (DeLone and McLean, 2003), online learning system in Taiwan (Lin, 2007), Finland (Iivari, 2005), etc, testing the model in the context of banking sector of LICs is not a common phenomena. When looking known databases of IS journals, to verify whether this model is tested in the context of LICs or not, very few hits were returned (like Brown and Jayakody (2008) work which tested the model in South Africa's e-commerce context). This literature gap initiated the researchers to pose a question as to whether the IS Success Model is thoroughly tested and validated in all contexts or not.

Moreover, given the lack of enabling infrastructure to properly execute ICT application in LICs, the completeness of the model in identifying the causes of IS Success in LICs is questionable. Especially, the role of IT Infrastructure (ITI) in IS Success model is not clear. ITI is a foundation for business applications (Duncan, 1995). The quality and extent of information sharing, storage, and processing is directly related to the capability provided by organization's ITI (Lewis and Byrd, 2003). Strategic organizational initiatives such as e-Commerce are dependent on solid ITI (Lewis and Byrd, 2003, Zhu and Kraemer, 2002). We can see this in the impulsion of 'dot-com's due to lack of robust IT Infrastructure (Lewis and Byrd, 2003 citing Straub and Watson, 2001). Lack of enabling ITI has limited the use of e-Banking system in Ethiopia (Worku, 2010). Furthermore, ITI is found impacting development and implementation of global IS (Martin, Scheraga, Moran and Nagrath, 1997). Despite these facts, the role of ITI in the IS Success model, particularly, the relationship it has with constructs Use and User satisfaction is not clear.

This research, therefore, aims to fill these gaps by answering the following research questions: *is the DeLone and McLean Information System success model valid in low income countries context? and what is the role of ITI to Use and User satisfaction in this Model?*

This paper is organized in five sections. The second/next section gives background on the case. The third section deals about theoretical model used and the construct to be tested. The research method is highlighted in fourth section. The fifth section shows concluding remarks. As the paper is reporting work in progress, it has not included data collection, analysis, and recommendations. Nevertheless, constructs, customized measures and survey instruments are attached in the appendixes. Pre-testing and validation of the survey instrument is in progress. The results will be presented on the conference.

TEST CASE BACKGROUND

In Ethiopia, indigenous private banks are flourishing for the last 15 years. These banks are growing quickly from their infant stage (Kiyota et al, 2008). Now the number of private banks alone has reached 15 by 2010. The financial sector, in which these Banks are in, has "continued to expand" significantly contributing to the growth of the service sector of the country (NBE, 2010).

Some Banks in Ethiopia have started providing automated services. But considerable numbers of banks have not started automating their services as they are facing financial capital shortage and doubts on investment return. However, it is natural to expect these banks learn from the other banks implementation and success before investing huge amount of money required for the new systems.

The banks that have implemented information systems have established IS/MIS/IT departments to manage the IS and the ICT infrastructure. Some of these banks are Awash Bank, Commercial Banks of Ethiopia (CBE), Dashen Bank, United Bank and Wogagen Bank. Except CBE, the other banks are privately owned (NBE, n.d). The systems being used by these banks are Bank Master by Awash, FLEXCUBE by Dashen and United banks and Smart Bank by Wogagen and Temenos Core Banking (TCB) system by CBE.

CBE is the largest and long serving commercial bank in Ethiopia (Worku, 2010) and largest bank in Eastern and Central Africa by branch network (IBM, 2011). CBE was established in 1941(CBE, 2011). It has an asset of Birr 114 billion as of June 30th 2011, 504 branches and over 2 million customers (CBE, 2012). In addition to the branches in the country, the Bank began providing service outside the country in Juba, South Sudan (CBE, 2011).

CBE has started using the core banking system called TCB in 2012 (Belete, 2012) though the implementation is not completed in all branches. However, it commenced work in 35 branches (Belete, 2012). The TCB system is a trademark of Temenos Headquarters SA, Geneva, Switzerland. It is being used by over 500 clients in over 100 countries (Gebreselassie, 2012). Some of its functionalities are Customer Data Administration, Customer profile organization, Settlements & Posting, IntraBank Alerting and Notification, Lending, Deposit, Payment service, operational data store among others (Temenos, 2011). TCB is being implemented by NIB Bank, Construction and Business Bank (CBB) and Bank of Abyssinia (Gebreselassie, 2012) in the country.

THEORETICAL BACKGROUND

The concept of IS success has got attention in the IS community (Rai, Lang and Welker, 2002). It is defined as completion of system development on time and under budget, with a complete set of features that are consistent with specifications, correctly functioning, attracting a large, loyal, and growing community of users, reducing uncertainty of outcomes, lowering risks, leveraging scarce resources and improving user's job performance (Briggs, Vreede, Nunamaker and Sprague, 2003). The definition entails both use and development aspects of IS. In this research, however, focus is only on success after implementation in banking context. Thus IS success in this research context is attracting growing and loyal customer, minimizing transaction cost, increasing and widening deliverable services, increasing employee productivity, correctly functioning, lowering risks, fast and timely service delivery, leveraging scarce resources, and reducing uncertainty of outcome. Despite the attention and a number of works on IS success, there was lack of comprehensive theoretical explanation of IS success in prior works (DeLone and McLean (1992). DeLone and McLean (1992) and Seddon (1997) responded to this gap. They published two models on IS success. The first model was published in 1992 (DeLone and McLean, 2003). After intensive testing and validation of the 1992's model, the second, updated and re-specified model appeared in 2003 (DeLone and McLean, 2003).

The updated IS success model constructs are information quality, system quality, service quality, intention to use/use, user satisfactions and net benefits (DeLone and McLean, 2003). These constructs are arranged based on their interdependence and causality (Almutairi and Subramanian, 2005). Information quality, Service quality and System quality are independent constructs, while intention to use or use and user satisfaction are intermediary constructs that impact the dependant construct Net benefits (DeLone and McLean, 2003).

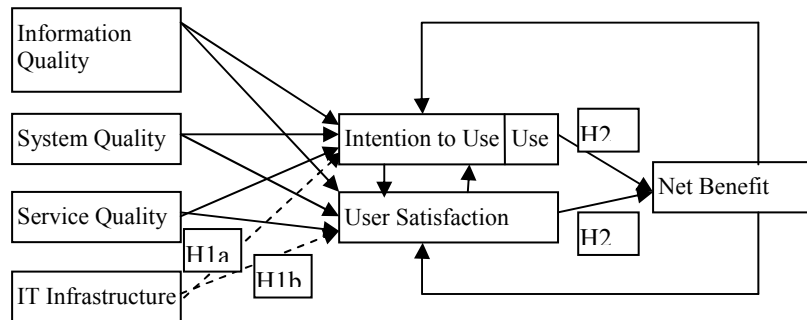


Figure 1. DeLone and McLean IS Success Model with tenuous relationship with ITI

Information quality refers to measures of IS output (DeLone and McLean, 2003). It is the information product desired characteristics such as accuracy, precision, currency, timeliness, reliability, completeness, conciseness, format, relevance, understandability, report usefulness, sufficiency, freedom from bias, comparability, and quantitative-ness (Negash, Ryan and Igbaria, 2003).

The construct System quality is information processing systems' desired characteristics (DeLone and McLean, 2003). These desired characteristics include convenience of access, flexibility, integration, response time, realization of user expectations, reliability, ease of use, ease of learning, usefulness of IS, etc (Liu, 2001).

IS Departments ability to provide services such as installation assistance, product knowledge, software training and support, and online help is a factor that will have an impact on the relationship between IS and users (Pitt, Watson and Kavan, 1995). The quality of such service is the difference between what a user expects to be offered and what is actually provided (Pitt et al., 1995).

Use of IS refers to recipient's consumption of the output of an IS (Liu, 2001). Iivari (2005) interprets Use as the amount of use of the IS. Use is behavior and intention to use is users' intention to use the system (DeLone and McLean, 2003)

The other construct in the model is User satisfaction. User satisfaction is the recipient's response to the use of IS output (DeLone and McLean, 2003). It is the extent to which a user believes that the system meets his/her information requirements (Sabherwal, Jeyaraj and Chowa, 2006).

The dependant variable in the model is Net benefit (DeLone and McLean, 2002). It is the positive impact of the system on individuals and organizations (DeLone and McLean, 2002). It measures comprehensively the sum of all past and expected future benefits, less all past and expected future costs (DeLone and McLean, 2003, Seddon, 1997)

In this research, though the relationship of the constructs: Information Quality, System Quality and Service quality; to Intention to use or and User satisfaction was intended for scrutiny initially, we now focused only on the study of the

relationship between the constructs: IT Infrastructure, as exogenous variable, and Intention to use or use and User satisfaction, as intermediary variables; and Net benefit, as endogenous variables.

CBE expects return from IS investment. However, ISs in LICs were not always successful; several failures reported in the research community (Avgeru and Walsham, 2000). Thus the success of IS in the context of LICs is dependent on many factors, than only what is mentioned by DeLone and McLean (2003).

ICT/ITI infrastructures is defined as “the organized, shared IT resources of hardware, software, communication technologies, data, core applications, and practices that provide a unique technological foundation for widespread communications interchanges across an organization, for the design, development, implementation, maintenance, and management of present and future business application, and to support innovation within the organization” (Lewis and Byrd, 2003). ITI plays great role to benefit from fruits of ICT (IFIP, 2007). IT Infrastructure (ITI) is reported also to have impact in attracting Foreign Direct Investment (FDI) (Addison and Heshmati, 2004). In some businesses ITI has been identified as critical factor on the firm's ability to use IT competitively (Duncan, 1995). The level of implementation and use of these technologies is not also homogeneous across countries and areas as they depend on network infrastructure (IFP, 2007).

Measures to indicate ITI are adopted from validated instruments of Lewis and Byrd (2003) and Byrd and Turner (2000). Some of the indicators are data communications between central and distributed facilities (Lewis and Byrd, 2003), data shared between users and departments (Lewis and Byrd, 2003), data security (Lewis and Byrd, 2003), available connections (Byrd and Turner, 2000), communication bottlenecks (Byrd and Turner, 2000), etc. Moreover, we have included cost and reliability as indicators of ITI as they describe status of it in LICs (Etta and Parvyn-Wamahiu, 2003, Littlejohns, Wyatt and Garvican, 2003). Detail of the measures adapted and survey instrument questions are attached in Appendix 1 and 2 respectively.

LICs are characterized by lack of sufficient ITI (Etta and Parvyn-Wamahiu, 2003). However, it is not yet clear whether these issues have direct impact on success of IS or not. But we presume ITI has positive relationship with use as many people intend to use certain technology if there are adequate infrastructures for that, and vice versa. Many tele-centers in Africa did not function properly due to lack of appropriate infrastructure (Etta and Parvyn-Wamahiu, 2003). We presume also User satisfaction has positive relationship with ITI as availability and quality of ITI can affect output of the TCB. Since these presumptions are tenuous (Please look Figure 1 above), the following hypotheses are drawn to verify the relationship empirically. *H1a: ITI positively affects Intention to Use or Use of TCB system*, and *H1b: ITI positively affects User Satisfaction of TCB system*.

The other construct, Use, determines Net benefits (DeLone and McLean, 2003). It means using the system (Seddon, 1997). Net benefit depends on critical mass of use (Markus, 1987). To measure TCB's use or intention to use, indicators such as frequency of use (Iivari, 2005), number of transactions served (DeLone and McLean, 2003) and use of number of functionalities of the system (Gizberg, 1981) are adopted. DeLone and McLean (2003) model specifies that intention to use has a positive influence on net benefit. Empirical tests attest this relationship (Iivari, 2005; Wang and Liao, 2008). We also hypothesize this relationship to hold true: *H2: Intention to Use or Use positively affects Net Benefit*.

User satisfaction in the context of banks is the satisfaction of employees in using the system while providing services to clients and executing jobs, i.e. transferring money, customer registration, assigning employees privileges, etc. The indicators are job satisfaction and output that meet employs expectations (Luarn, Lin and Lo, 2005). In addition to the claim of DeLone and McLean (2003), Wang and Liao (2008) and Iivari (2005) have also shown empirically that user satisfaction has positive impact on net benefits. To test this relationship we hypothesize: *H3: User Satisfaction positively affects Net Benefit*.

Net benefits of Banks could be retaining and increasing customers, fats service to clients, eliminates human-error, security, confidentiality and finally lower costs (Abd, Mahmoud and Saleh, 2005). In this research customer number, service delivery duration, human-error, cost and customer satisfaction are taken as indicators of net benefit.

METHOD

Field study, following positivist approach, using survey technique, is the research strategy followed. Document analysis will be conducted in order to enrich the data collected in the survey. Documents such as financial statements and periodic reports will be reviewed regarding number of customers, savings, and customers/clients comments.

Validation of the survey instrument is being carried-out though we adapted validated instruments from prior researches (Please refer Appendix 1 for the details). The Survey instrument uses 5 point Likert scale. Survey questions based on the adapted measures is sated in Appendix 2. Outcome of the validation of the survey instrument, based on the pilot survey, will be presented on the conference. For the instrument validation undergoing 60 questionnaires is sent for distribution to CBE employees.

Six branches running TCB system are selected randomly for the survey. For the purpose of comparison, we have selected one branch without TCB system. The target population in this research is 150, possibly 15 in each branch and the rest from Head

Quarter. We expect a 75% response. Thus, securing above 100 questionnaires, and meet what Hoelter (1983) dubbed as ‘good sample size’ (Lewis and Byrd, 2003 citing Hoelter, 1983). The targets are employees, managers and system administrators at branches and the head quarter office (Operations and MIS departments). Random sampling will be used to select employees from each stratum. Partial Least Square will be used to analyze the data. Smart PLS software will be used for data analysis.

CONCLUSION

The expected result of this research is validation of the DeLone and McLean IS success model by considering contextual constructs relevant to LICs, i.e. ITI. Thus, the research contributes in enriching the revised DeLone and McLean IS success model from the perspectives of LICs. The identification of contextual factors impacting IS helps managers, both in LIC and international, to better manage both local and global IS towards success.

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APPENDEXES

Appendix 1: Measures in each constructs

Construct	Determinants in each construct	Definition and References
IT Infrastructure	Data communications between central and distributed facilities, Data shared between users and departments, Network integration, Data security, Access Control Security, Security awareness program, Cost, Reliability, Available connection, Assimilation into infrastructure, Easily connect-ability to central office, Communication bottlenecks,	Duncan, 1995, Citing McKay and Brockway (1989), Lewis and Byrd, 2003; Byrd and Turner, 2000
Use/Intention to use	Frequency of use, Use of different functions,	Seddon, 1997, Liu, 2001, Iivari (2005)

	Number of transactions executed.	
User satisfaction	Meeting requirements, Job satisfaction, Output satisfaction	DeLone and McLean, 2003; Sabherwal et al., 2006; Brown and Jayakody, 2008; Rai, Lang and Welker, 2002
Net benefits	Reduction of cost, Increase in revenue, Customers satisfaction, Competitive advantage, Customer loyalty, Overall productivity	DeLone and McLean, 2003; Seddon, 1997.

Appendix 2: Survey Instrument

Code	Item	Indicate your level of agreement or disagreement by Ticking (√) on one of the columns below. N/A stands for Not Applicable.					
		Strongly disagree	Sometimes disagree	Neutral	Sometimes agree	Strongly agree	N/A
	Net Benefit						
NB1	I feel TCB system has contributed in increasing CBE’s revenue.						
NB2	I feel TCB system has contributed in decreasing CBE’s cost of transaction processing.						
NB3	I feel TCB system has enabled to satisfy CBE’s customers.						
NB4	I feel TCB system has enabled increase CBE’s overall productivity.						
NB5	I feel TCB system has enabled increase CBE’ competitive advantage.						
NB6	I feel TCB system has enabled increase CBE’s customer loyalty.						
	Intention to Use/Use						
US1	I use the TCB system routinely.						
US2	I use different functions of TCB system.						
US3	I use TCB to handle many transactions per day.						
US4	I am dependant on TCB system.						
	User Satisfaction						
USA 1	I feel TCB meets my requirement.						
USA 2	I am satisfied after using TCB systems.						
USA 3	I am satisfied by the outputs of TCB system						
	IT Infrastructure						
ITI1	While using TCB system, data communication between the central and branch offices is always available.						
ITI2	The IT infrastructure that supports the TCB system is						

	reliable.						
ITI3	While using TCB system, IT infrastructure supports sharing data between users and departments.						
ITI4	While using TCB system, IT infrastructure supports data security.						
ITI5	While using TCB system, IT infrastructure supports access control.						
ITI6	While using TCB system, IT infrastructure supports security awareness programs.						
ITI7	For TCB system use, there are no communications bottlenecks within our organization.						
ITI8	For TCB system use, our organization has the foremost available IT systems and connections (e.g., ADSL, VDSL, ATM, SDV)						
ITI9	For TCB system use, all remote, branch, and mobile offices are connected or can be connected easily to the central office						
ITI10	Cost of IT infrastructure of TCB system is fair.						
ITI11	New locations or acquisitions are quickly assimilated into our IT infrastructure						