



The Antecedents of Information System Success in The Banking Industry: An Empirical Investigation of The DeLone and McLean Model

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Abstract: The transformation of various organizations into an innovative technology, specifically, information system (IS), should have a positive impact the flow of work procedure within the banking industry. The main aims of this study is to recognize the success of banking systems from users' perspective, who work in banking industries. This study is motivating due to the rapid growth of applying IS in the banking industry's in developing countries such as Sudan which is require more evaluation. In this study, the DeLone and McLean (D&M) model applied as one of the major models that assess the success of IS. The proposed model consist of six constructs include system quality (SYQ), information quality (INQ), service quality (SVQ), system use (SU), user satisfaction (UST), and net benefits (NBs). The results of the study support and confirm that there are significant relationships among the success variables. All relationships of study hypotheses supported, except the relationship between SYQ and UST, as well as between SVQ and SU. The discussion and empirical evidence presented can assist the Sudanese banking industry to improve and fully utilize the possibility of banking information systems as a new tool for banking information evaluation purposes.

Keywords: Information system, IS success model, (D&M) model, User satisfaction, Net benefits

1. Introduction

Information system (IS) is one of the most important components of the environment of business at present because they offer a large opportunity for success in organizations; given that they have the capability of, distributing, processing, and information sharing in timely and an integrated. Moreover, they help decision-makers and staffs to be more effective (Stefanovic, Marjanovic et al. 2016), which in turn lead to improvement of the business processes, and the information management, consequently, resulting in a positive effect on the competitiveness and productivity of the firms (Rai, Patnayakuni et al. 2006), (Cortés and Landeta 2013), (Bakos and Treacy 1986).

Information systems are a new era for organizations and the industry. Nowadays, organizations are desired to use IS in order to keep competitive advantage in the market and maintain the business operations (Martin, Brown et al. 1998). However, it is still a challenges to use IS success in business operations and reach valuable information. In (Oyelaran-Oyeyinka and Lal 2006) author confirmed on the importance of IS with illustrating that IS had a significant role for success of a companies under unstable market environments and uncertain economic conditions. IS not a shiny factor that increases the profit and saves the business; However, by the efficient use of IS, it can help to improve the performance of the business (Powell and Dent-Micallef 1997); (Ruiz-Mercader, MeroñO-Cerdan et al. 2006).

The banking industry in Sudan is the main investor in the use of information technology. In addition, the Sudanese banking industry was among the first to include the processing of electronic information in its procedures, through ATMs and check treatment, bookkeeping credit analysis (Adam 2012). The successful of banking system an expected to provide Sudanese banking industry by critical information which assists them to become more competitive, internal business operations and integration among trading partners. As information is considered as the bloodline of any activities in today's global business, IS quality and effective plays an important role that can assist banking to provide the necessities of the correct of information at the right time.

The main aim for this research is to understand the importance of quality factors of IS that can lead to the success of banking information systems application through system use and users' satisfaction in the context of the banking industry in Sudan. The quality factors of IS considered in this study were adopted from the D&M model of IS success. This study tries to deal with the scarcity of the prior study with quality factors of the banking information system, specifically in the context of banking industry in Sudan. The study will be beneficial to academics in further developing and testing the success of banking information systems model, where these systems are important to the employees to accomplishing their daily tasks.

The remainder of the study is structured as follows. Part 2 literature review. Part 3 describes the hypotheses development and study model. Part 4 details the research methodology. Part 5 describes the results for empirical study and influencing factors using IS bank data. Part 6 discusses the results. Part 7 validated the performance of the proposed model. Part 8 summarizes and concludes the study, and Part 10 addresses the limitations and future work directions.

2. Literature Review

IS has become very important and significant effect on the commercial processes, therefore have attracted large investment levels (Petter, DeLone et al. 2008). Despite the expected advantages, a few studies actually test the achievement of such systems to ensure achieve the benefits. Nevertheless, IS success assessing is challenging due to the lack of agreement on contributing variables (Irani, Sharif et al. 2001), due to the following: Firstly, work practices and information systems are very complex, therefore, making it difficult to understand their separate effect on the success (Agourram 2009). Secondly, the impact of IS performance is indirect and is affected by several variables, such as organizational, environmental and peoples ones. The technical and social aspects with each other, make such measurements very complicated (Petter, DeLone et al. 2008). Thirdly, the methodological aspects that are used to measure IS success in which detecting dependent variables is very difficult (Agourram 2009).

DeLone and McLean (1992) proposed model to measure the success of IS, the model introduces six main variables which include "system quality"; "information quality"; "use"; "user satisfaction"; "individual impact"; and "organizational impact" as presented in figure 1 (DeLone and McLean 1992). By using above factors, they review the theoretical and empirical literature and suggest a descriptive model of IS success. In addition to discussing the assumptions and implications of searching for the success of the dependent variable (Petter and McLean 2009). D&M model is an important development in promoting research IS success in different respects. First, it supports prior studies. Second, it classifies and organizes the measures of IS success. Third, it begins to classify different groups of stakeholder in the procedure. Finally, it has been adopted as an appropriate basis for further theoretical and empirical studies, and has met with general acceptance such as (DeLone and McLean 1992). D&M model has been commonly accepted and utilized in IS studies (Cho, Park et al. 2011).

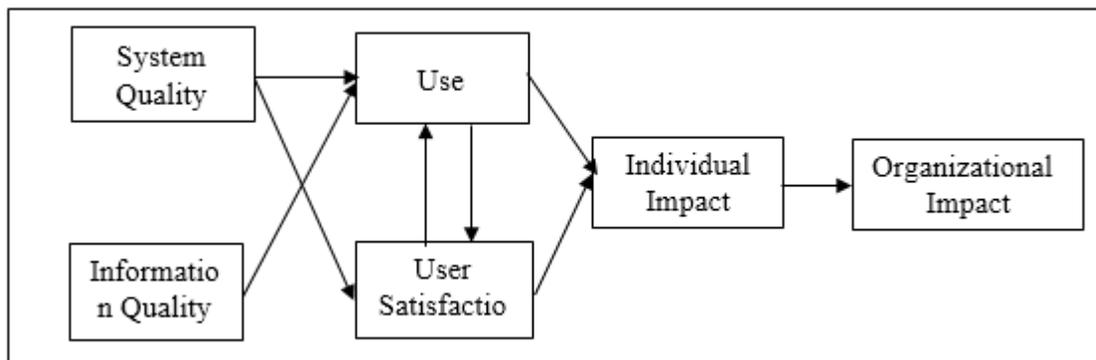


Figure 1. DeLone-McLean Model for IS Success (1992)

Delone and McLean (2003) have made some and important changes to their original model for over more than a decade to reflect the changes in needs of users and technologies, see figure 2. They have merged "individual impact" and "organizational impacts" in "net benefits". In addition, they have included 'service quality' as a third characteristic, to their model. The items that contribute to service quality are, reliability, responsiveness, assure and empathy. In their

original model, “service quality” was a part of system quality (Delone and McLean 2003). Most empirical studies supported the part of the D&M model, which proposed that “System Quality”, “Information Quality” and ‘Service Quality’ cause ‘User Satisfaction’ and ‘System Use’ (Petter, DeLone et al. 2008). It has been confirmed that quality effects behavior and attitude in an IS context. Nevertheless, various discussions have started on the build of IS success model. The construct of IS success is differed according to the field (Gorla, Somers et al. 2010).

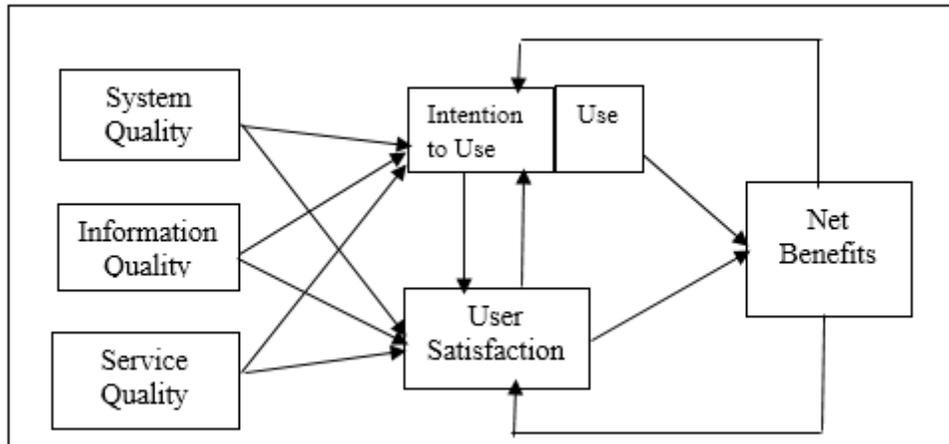


Figure 2. Updated DeLone-McLean Model for IS Success (2003)

2.1 Banking Systems

The banking systems would not only provide excellent banking services to the customer generally but would also support the users to improve their performance and effectiveness of the jobs (Aithal 2016). Banking systems such as e-payment, e banking, the banking system used in our study, help the Sudanese banking industry to attract and grow loyal customers, reduce the cost of the transaction, develop services of banking, and improve the bank’s competitive condition (Mansour, Eljelly et al. 2016). There are different types of banking systems in Sudanese banking industry:

2.1.1 Benta banking system: Benta banking system in Sudan provides six types of services at the headquarter level, 17 types of services at the branch level, and 6 types of accessory services. These banks differ in the degree to which they apply or adopt Benta Banking system. Some of banks use only part of the services provided by the system in addition to other services such as bank phone. E-payment, E-banking, and E-pass, Benta Banking system is characterized by the use of interrelation database (Oracle), restriction transferor, and provides high level of information security. Furthermore, this system provides non-conceptual services like automatic clearing. Until now, Sudanese banks did not fully utilize Benta Banking information system (Adam 2012).

2.1.2 Bank plus system: bank plus system allows the possibility of depositing and drawing, e banking, and a number of services through the Internet, like transfers inquiries, applications for opening a new account, prices of foreign currency, and indicators of international money markets. (Adam 2012).

2.1.3 Bank-ware system: this system uses a number of basic systems such as customers database system and its central aggregation, which provide information to customers as related to deposit accounts, branches electronic connections, salaries and wages, chq books, clearing, credit accounts payable, investments, profit calculations, and transfer system (Adam 2012).

3. Hypotheses Development and Research Model

The study proposed model illustrated in figure 3 which adopted the D&M model of IS success. In constructing our model, we defined variables that had been classified as the main factors of IS success, especially among banking industry. In consent, the IS Success Model (DeLone and McLean 2002), (Delone and McLean 2003). Our study model posits that SYQ, INQ, and SVQ determine the SU of the banking system - based on the systems in banks. The model also suggests that SYQ, INQ, and SVQ will have a positive influence on UST. In addition, SU and UST will have a positive influence on NBs. Fig. 3 demonstrates the study model, and the hypotheses are displayed in table 1 and briefly explained in the following paragraphs of this part.

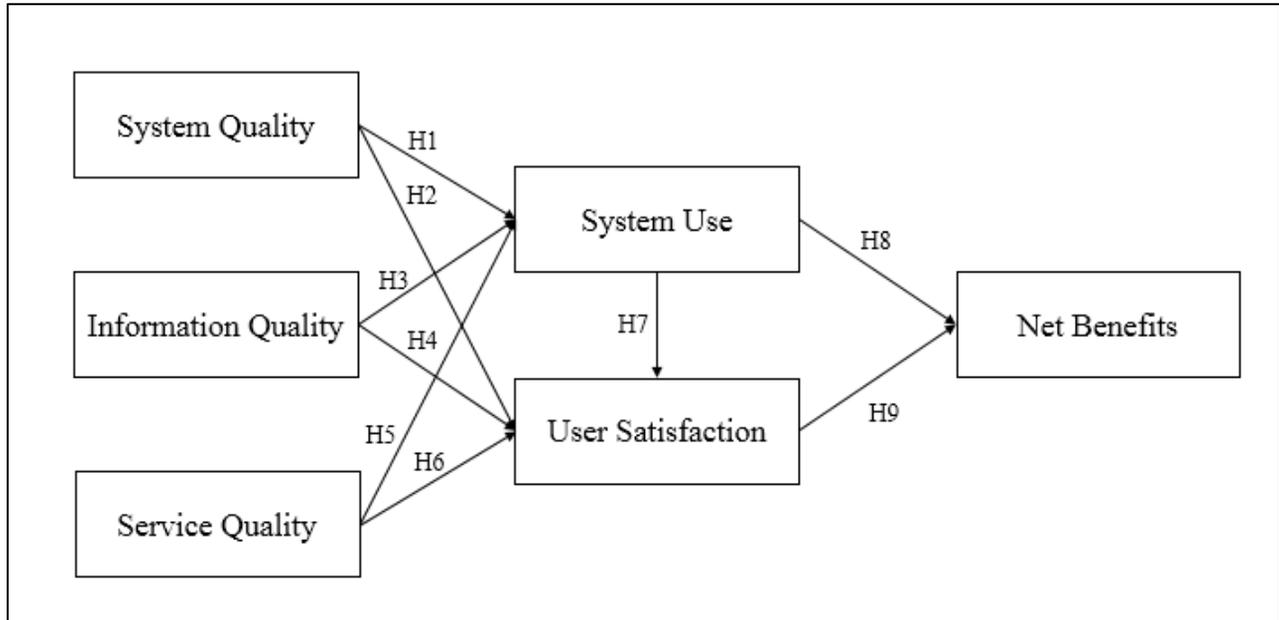


Figure 3: Proposed research model

Table 1 Description and Suggested Relations of The variables Included for Measuring IS Success of banking systems

Constructs	Description of constructs and proposed relationships with dependent constructs	Supporting reference
System Quality	Refers to the features of an information system, which will positively influence system use and user satisfaction.	(Delone and McLean 2003), (Urbach and Müller 2012), (JAAFREH 2017)
Information Quality	Refers to the desirable characteristics of output of an information system, which will positively influence system use and user satisfaction.	(Delone and McLean 2003), (Urbach and Müller 2012), (JAAFREH 2017)
Service Quality	Represents the quality of the support that the system users receive from the technical staff, which will positively influence system use and user satisfaction.	(Delone and McLean 2003), (Petter, DeLone et al. 2013)
System Use	Use is a measure of the spread of the technology, and is probable to have a significant impact on user satisfaction and net benefits.	(Delone and McLean 2003)
User Satisfaction	Refers to the degree of happiness obtained from the use of the technology in question, and is probable to have a significant impact on net benefits.	(Borena and Negash 2016)
Net Benefits	Net Benefits is the extent to which the information system contributes to the success of users	(Delone and McLean 2003), (Petter, DeLone et al. 2013)

3.1 System Quality

System quality (SYQ) refers to an IS features, and therefore, accounts for measures of the IS it same which specifically concentration on the characteristics and aspects performance of IS (Urbach, Smolnik et al. 2011). According to (Wu and Wang 2006) SYQ is Includes with the following: ease of use, system errors, response time, flexibility and stability. In addition, (Kim, Oh et al. 2009) validated the important influence of SYQ on the SU. (Petter and McLean 2009) Conducted meta-analysis of results obtained in nine published research that tested the impact of SYQ on UST and SU. The results of their study explained that, generally, SYQ had a significant and strong impact on the SU and UST. Based on the above-mentioned discussion, it can be supposed that the higher of the SYQ in the Sudanese banking industry, the more probable it is that IS will be used and the users will be satisfied. Therefore, the study hypotheses are following have been suggested:

H1: There is a positive relationship between system quality and system use.

H2: There is a positive relationship between system quality and user satisfaction.

3.2 Information Quality

Information quality (INQ) means to the quality of the output of the IS produces. INQ is a term to describe the quality of the content of IS (Alla and Faryadi 2013). (Nelson, Todd et al. 2005) propose that in addition to output quality, INQ should determine who uses the information, the tasks being completed and the applications being used. Thus, INQ would be the degree to which the information helps a user's in completing a given task. (Urbach, Smolnik et al. 2011) Indicated that the INQ is 'oftentimes seen as an important antecedent of UST'. (Floropoulos, Spathis et al. 2010) explained that INQ has a stronger effect on UST and perceived usefulness of IS in the Greek Taxation. (Kim, Oh et al. 2009) demonstrated the stronger and significant impact of INQ on the SU. (Petter and McLean 2009) carried out a meta-analysis of results reported in published studies that tested the influence of INQ on SU (5 research) and UST (10 research). The results from their study confirmed that, INQ had a positive effect on UST (across 10 research) and SU (across five research) (Petter and McLean 2009). Based on the above-mentioned discussion, we supposed that the greater the INQ of IS in the Sudanese banking industry, the more probable it is that the IS will be used and the users will be satisfied. Therefore, the study hypotheses are following have been suggested:

H3: There is a positive relationship between information quality and system use.

H4: There is a positive relationship between information quality and user satisfaction.

3.3 Service Quality

Service quality (SVQ) as one of the most a key measures of success of IS, due to the significant role of the IS department and the expanded of IS (Chiu, Chiu et al. 2007). SVQ defines as the overall support provided by the provider of service through the IS department, outsourced to the provider of internet service or a new organizational unit (Delone and McLean 2003). SVQ is the comparison between what the users feel should be obtainable as their expectation and what is really delivered according to their understanding (Jiang, Klein et al. 2003). According to (Pérez-Mira 2010) SVQ denotes to all direct or non-direct assistances obtainable which relative to purchase or service that the companies or organizations has to offer, to promote, the experience of the customer. (Delone and McLean 2003) explained that if the supports of users is poor, it will lead to decreased sales and lost customers. Therefore, satisfying the expectations of users will inevitably leads to increased UST (Pitt, Watson et al. 1995). The empirical investigation by (Floropoulos, Spathis et al. 2010) confirmed the positive and significant effect of SVQ on UST and perceived usefulness. (Udo, Bagchi et al. 2010) also confirmed that the significant and positive effect of SVQ on SU and UST. Based on the prior studies, which explained above, the following hypotheses have been suggested:

H5: There is a positive relationship between service quality and system use.

H6: There is a positive relationship between service quality and user satisfaction.

3.4 System Use

System use (SU) is defined as the utilization of applications of information technology by persons, groups or organizations (Straub, Limayem et al. 1995); the model of IS success proposes that net benefits is directly influenced by SU. Several previous research provided support concerning the positive and significant influence of SU on the net benefits (NBs) such as (Devaraj and Kohli 2003); (Teng and Calhoun 1996); and (Zhu and Kraemer 2005). (Urbach, Smolnik et al. 2011) define SU as the degree in which IS used, and they explained that measuring the SU is a comprehensive concept, which can be studied across numerous aspects. (DeLone and McLean 2002), (Delone and McLean 2003), and (Delone and Mclean 2004) they stated that the effective usage of the system is very important indicator to success of IS. Several of prior studies explained that there is a positive association and a significant effect between SU and UST. Based on the above-mentioned, we can said that the greater use of IS in Sudanese banking industry, the more probable it is that the users will be satisfied, and we also believe that the use of the system can create important benefits for organizations, particularly in developing countries. Consequently, the following hypotheses have been proposed:

H7: There is a positive relationship between system use and user satisfaction.

H8: There is a positive relationship between system use and net benefits.

3.5 User Satisfaction

User Satisfaction (UST) is considered as one of the most commonly success measure of IS models (Seddon and Kiew 1996). (Bailey and Pearson 1983) refer UST as the sum of person's attitudes and feelings toward a variety of variables that influencing of situation. According to (Delone and McLean 2003), satisfaction with IS can have a significant influence on NBs. The significant affecting of this relationship at the analysis of organizational level was validated by several previous IS research (Petter, DeLone et al. 2008); (Urbach and Müller 2012). IS literature confirms that at the organization-wide satisfaction and the analysis organizational level with IS has resulted in improved job satisfaction, enhanced performance, increased productivity and enhanced decision making (Gelderman 1998); (Law and Ngai 2007).

This particular relationship among organizations also has been supported by several previous studies. Therefore, the following hypothesis has been proposed:

H9: There is a positive relationship between user satisfaction and net benefits.

3.6 Net Benefit

Net benefit (NBs) is the effect of the IS on employees or users of the organization, and organization itself (Delone and McLean 2003). According to (Caldeira and Ward 2002) NBs is evident that the IS can offer a variety of benefits for companies such as improved job performance, improved task quality, employee’s productivity, procedure efficiency, competitive advantage, and development in decision-making are examples of IS success for companies. In the banking industry, IS benefits are frequently characterized as the results of the IS on the performance of these organizations (Thong 2001). Net Benefits’ measures, in our research, is defined as actual increase in productivity, effectiveness on the job, quality of work , performance, and get the solutions of job problems. As shown in table 3 summery of studies associated with IS success models and NBs as dependent variable.

4. Research Method

4.1 Measures

The variables of the model of research have been determined based on the prior studies on success of IS models. The items that have been used to analyze the success of different types of IS, in the prior research, which have been applied in the study model as shown in table 2.

Table 2: Construct Measures

Variable	Measure	Reference
SYQ	SYQ1: The system is easy to use.	(Delone and McLean 2003), (DeLone and McLean 2016)
	SYQ2: The system has response quick.	
	SYQ3: The system is easy to learn.	
	SYQ4: The system has reliability in functioning.	
INQ	INQ1: Information provided by the system is accurate.	(Tam and Oliveira 2017), (DeLone and McLean 2016)
	INQ2: Information provided by the system is relevant.	
	INQ3: Information provided by the system is easy understand.	
	INQ4: Information provided by the system is sufficient.	
SVQ	SVQ1: The IT staff provides is dependable service.	(DeLone and McLean 2016), (Tam and Oliveira 2017)
	SVQ2: The IT staff have quick respond to my needs.	
	SVQ3: The IT staff provides users with a fast service.	
	SVQ4: The IT staff have technical competence.	
	SVQ5: The staff of IT is available when I need them.	
	SVQ6: Staff of IT understands the specific needs of users.	
SU	SU1: I frequently use the system.	(Almutairi and Subramanian 2005), (Tam and Oliveira 2018), (DeLone and McLean 2016)
	SU2: I use many functions of the system.	
	SU3: I depended on the system	
	SU4: Using the system supports my work procedures.	
UST	UST1: I feel the system meets my requirement.	(Almutairi and Subramanian 2005), (Rai, Lang et al. 2002), (DeLone and McLean 2016)
	UST2: I am satisfied with the system efficiency	
	UST3: I am satisfied with the system effectiveness	
	UST4: Overall, I am satisfied with system.	
NBs	NBS1: I feel the system has increase banks productivity.	
	NBs2: I feel the system improves the quality of the work.	

NBs3: I feel the system enhances the effectiveness in the job.	(Wang, Cho et al. 2017),
NBs4: I feel the system has enabled increase banks competitive advantage.	(DeLone and McLean
NBs5: The system provides the solutions for the job problems	2016)

Note: SYQ= system quality, INQ= information quality, SVQ= service quality, SU= system use, UST= user satisfaction, NBs= net benefits.

4.2 Instrument Design

The data of the research were collected by a questionnaire survey was it developed based on the literature review. The questionnaire is consisting of seven sections with 34 questions. The questionnaire was offered to academic’s experts for the determination of adjudging face and content validity.

The answers were obtained on 7-point liker type scale ranging from strongly disagree to strongly agree (1=” Strongly disagree” 2= “Disagree”, 3= “Somewhat disagree”, 4= “Neither agree nor disagree”, 5= “Somewhat agree”, 6= “Agree”, 7= “Strongly agree”).

4.3 The Sample of Research

The study sample of this study includes Sudanese banks in Khartoum state. Personal administered questionnaires were used to collect the data from bank employees. Questionnaires are distributed to 15 banks, in three cities in Khartoum these cities are: Khartoum, Khartoum Bahri, and Omdurman, which consider the main cities in Khartoum state. We identified 140 sample respondents, and we received 102 questionnaires, contributing 72.9% to the response rate. The data are analyzed through statistical process of analysis. Table 2 show the sample demographic information.

4.4 Data Analysis

The literature review was conducted out on the IS success assessment models and on the effect of the services of IS in the firms. The technique of structural equation modeling (SEM) was used to test the relationships among the constructs of the model. This was done using the SMART PLS V3.2.7 software and SPSS V22.

5. Findings

5.1 Information of the demographics

Demographics information of the survey participants presented in table 3, showed: gender, age, education, position, working experience, computer skills, and computer experience. Table 3 shows that the largest ratio of participants are 31 less than 40 years old, and (62.7%) male.

Table 3: Demographics information

Variable	Group	Frequency	Percent (%)	Variable	Group	Frequency	Percent (%)
Gender	Male	64	62.7	Working Experience	≤ 1	3	2.9
	Female	38	37.3		≤ 2	7	6.9
Age Group	0 -30	26	25.5	≤ 3	12	11.8	
	31-40	27	26.5	≤ 4	12	11.8	
	41-50	24	23.5	≥ 5	68	66.7	
	≥ 50	25	24.5	≤ 1	4	3.9	
Position	AS ¹	31	30.4	Computer Experience	≤ 2	10	9.8
	TS ²	9	8.8		≤ 3	15	14.7
	HD ³	29	28.4		≤ 4	11	10.8
	Manager	14	13.7		≥ 5	62	60.8
Computer Skills	Others	19	18.6	Education	Diploma	7	6.9
	Low	3	2.9		Bachelor	62	60.8
	Average	53	52		Master	29	28.4
	High	46	45.1		Others	4	3.9

Note: ¹ Administration staff, ² technical staff, ³ head of department.

5.2 Reliability Test

A test of reliability was carried out to assess the consistency of internal items of the survey for each variable, the consequences of which are displayed in table 4. Based on (Hinton, McMurray et al. 2004) Cronbach’s alpha

representative of reliability has four points, which are (1) 0.90 and above, indicating excellent reliability; (2) 0.70–0.90 for high reliability; (3) 0.50–0.70 indicating the moderate reliability; and (4) 0.50 and below for low reliability.

As shown by table 4, out of five variables utilized in our research, two variables have a high measure of reliability, whereas, the values of alpha for other variables indicate that the measurements have consistency of high internal comparatively. The greater values of Cronbach’s alpha for all variable suggest that all measures of the individual variable of which the instrument is included are greater internally consistency.

Table 4: Reliability and Validity Test

Constructs	Items	Items loading	Cronbach's Alpha	Composite Reliability	AVE
SYQ	SYQ1	0.782	0.819	0.881	0.649
	SYQ2	0.837			
	SYQ3	0.767			
	SYQ4	0.833			
INQ	INQ1	0.767	0.831	0.887	0.663
	INQ2	0.826			
	INQ3	0.865			
	INQ4	0.797			
SVQ	SVQ1	0.881	0.954	0.963	0.813
	SVQ2	0.928			
	SVQ3	0.904			
	SVQ4	0.914			
	SVQ5	0.905			
	SVQ6	0.878			
SU	SU1	0.817	0.880	0.918	0.736
	SU2	0.904			
	SU3	0.882			
	SU4	0.826			
UST	UST1	0.919	0.929	0.949	0.824
	UST2	0.909			
	UST3	0.914			
	UST4	0.888			
NBs	NBs1	0.803	0.902	0.928	0.720
	NBs 2	0.918			
	NBs 3	0.829			
	NBs4	0.867			
	NBs5	0.82			

Note: SYQ= system quality, INQ= information quality, SVQ= service quality, SU= system use, UST= user satisfaction, NBs= net benefits.

5.3 Discriminant Validity

There are two ways to assess discriminant validity. First, indicators’ cross loading. In table 5, we can be verifying discriminant validity by the test of the indicators' cross loading, comparing the load of each indicator on its variable with the load of the indicator on other variables. The loading of indicator should be higher on the associated variable than its loadings on other variables, confirming the discriminant validity. Second, compares the square root of the AVE with correlations of the latent variable (as presented in table 6), both ways indicate the discriminant validity of the research model.

Table 5: Cross Loadings

	SYQ	INQ	SVQ	SU	UST	NBs
SYQ1	0.782	0.557	0.394	0.41	0.409	0.402

SYQ2	0.837	0.652	0.483	0.43	0.497	0.416
SYQ3	0.767	0.492	0.259	0.479	0.344	0.39
SYQ4	0.833	0.555	0.296	0.595	0.424	0.465
INQ1	0.629	0.767	0.521	0.562	0.608	0.472
INQ2	0.507	0.826	0.378	0.446	0.493	0.463
INQ3	0.618	0.865	0.342	0.45	0.521	0.459
INQ4	0.501	0.797	0.264	0.522	0.404	0.484
SVQ1	0.315	0.391	0.881	0.365	0.452	0.364
SVQ2	0.421	0.417	0.928	0.343	0.521	0.236
SVQ3	0.424	0.462	0.904	0.368	0.509	0.298
SVQ4	0.438	0.42	0.914	0.335	0.543	0.304
SVQ5	0.482	0.474	0.905	0.421	0.546	0.375
SVQ6	0.287	0.394	0.878	0.29	0.452	0.212
SU1	0.532	0.488	0.388	0.817	0.409	0.552
SU2	0.536	0.612	0.376	0.904	0.556	0.636
SU3	0.552	0.522	0.264	0.882	0.52	0.614
SU4	0.436	0.478	0.328	0.826	0.609	0.566
UST1	0.466	0.524	0.529	0.507	0.919	0.518
UST2	0.425	0.534	0.481	0.491	0.909	0.485
UST3	0.446	0.54	0.521	0.505	0.914	0.531
UST4	0.536	0.671	0.504	0.683	0.888	0.667
NBs1	0.379	0.509	0.236	0.611	0.573	0.803
NBs2	0.52	0.553	0.308	0.617	0.567	0.918
NBs3	0.483	0.46	0.323	0.565	0.468	0.829
NBs4	0.431	0.441	0.263	0.607	0.468	0.867
NBs5	0.396	0.481	0.287	0.524	0.518	0.820

Note: Bold values represent standardized factor loadings of the items on their respective constructs; other values are the cross loadings.

Table 6. Construct Correlations and square roots of AVE

Constructs	Mean	Std. Dev.	AVE	SYQ	INQ	SVQ	SU	UST	NBs
SYQ	6.040	0.745	0.649	0.805					
INQ	6.153	0.734	0.663	0.701	0.814				
SVQ	5.825	1.141	0.813	0.443	0.474	0.902			
SU	6.074	0.876	0.736	0.599	0.614	0.395	0.858		
UST	6.033	0.949	0.823	0.521	0.632	0.561	0.611	0.907	
NBs	6.255	0.786	0.720	0.521	0.579	0.333	0.691	0.614	0.848

Note: SYQ= system quality, INQ= information quality, SVQ= service quality, SU= system use UST= user satisfaction, NBs= net benefits.

5.4 Hypotheses Testing

Hypotheses of study model are shown in table 7. Referring to the table, the path coefficients, which suggest the strengths of the relationship among the independent and dependent variables. R^2 value shown in table 9, which describes the amount of variance clarified by the independent variables (Rai, Patnayakuni et al. 2006). R^2 and the path coefficients denote how well the data support study model. For the predictive capability of the study model, R^2 of the dependent variables should be greater than or equal to 0.1 (Falk and Miller 1992). According to (Chin 1998) lower values offer a few information, whereas, the researchers propose that this value should be greater than or equal to 0.19. In our study, all the variables have acceptable predictive quality (as shown that in Table 8) all these hypotheses are discussed in more detail in section 7.

Table 7. Hypothesis Test

Code	Hypothesis	Coefficient (β)	(STDEV)	T Statistics	P Values	Result
H1	SYQ \rightarrow SU	0.312***	0.061	5.113	0.000	Supported
H2	SYQ \rightarrow UST	-0.016 (n.s)	0.067	0.222	0.824	Rejected
H3	INQ \rightarrow SU.	0.354***	0.056	6.274	0.000	Supported
H4	INQ \rightarrow UST	0.308***	0.071	4.343	0.000	Supported
H5	SVQ \rightarrow SU	0.087(n.s)	0.038	2.343	0.220	Rejected
H6	SVQ \rightarrow UST	0.298***	0.049	6.128	0.000	Supported
H7	SU \rightarrow UST	0.316***	0.075	6.721	0.000	Supported
H8	SU \rightarrow NBs	0.504***	0.044	7.041	0.000	Supported
H9	UST \rightarrow NBs.	0.306***	0.051	6.015	0.000	Supported

Note 1: SYQ= system quality, INQ= information quality, SVQ= service quality, SU= system use, UST= user satisfaction, NBs= net benefits.

Note 2: p<0.05 (*), p<0.01 (**), p<0.001 (***), n.s., not significant.

Table 8. R square

Constructs	R ²
System Use	0.439
User Satisfaction	0.542
Net Benefits	0.535

Q² has been used to measure the predictive competency of dependent variables of the study model. This test is calculated using the blindfolding Method in smart PLS. The Q² should be greater than zero so that the variable has predictive validity (Chin 1998), given that the values above zero show that the model predictability is appropriate (Sellin 1995). As can be illustrated in Table 9, all the values of Q² are above zero, which confirms the predictive relevance of the study model in relation to the dependent variables.

Table 9. Q square

Constructs	Q ²
System Use	0.303
User Satisfaction	0.414
Net Benefits	0.359

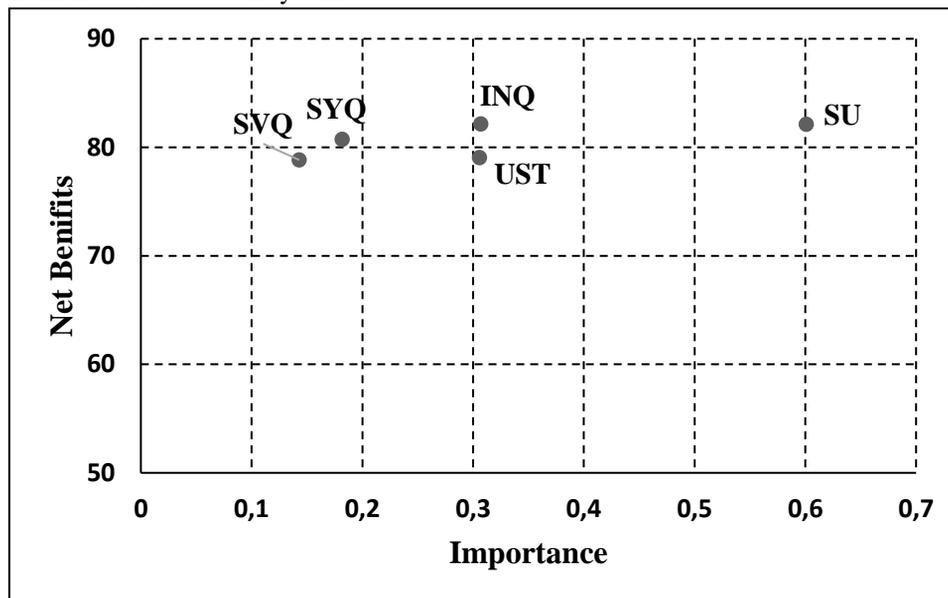
In this study, we used Importance-Performance Map Analysis (IPMA) as PLS process, to identify the influence on net benefits. IPMA has the ability to present the total effects estimates in correspondence to the salience of antecedent variables in influencing predicted variables; the scores of the average of the latent variables are in line with net benefits. Whereas, scoring of performance calculation was conducted through the rescaling of the rates of all latent variables, within values ranging from 0 to 100. IPMA improves the results of PLS examination because it gives consideration to the average value of the latent variables' as well as the indicators of these variables, in addition to performing the analysis of path coefficients. The values of total effect of IPMA for this results and the index of all these values are demonstrated in Table 10.

Table 10: Results of IPMA

Latent variables	performance total effect	Index values
System Quality	0.182	80.73
Information Quality	0.307	82.15
Service Quality	0.143	78.83
System Use	0.601	82.10
User Satisfaction	0.306	79.04

Total effects results and index values were presented on the map (see Figure 4). It was observed that system use (SU) have a greater effect in determining net benefits, as the result of its relative most significance in comparison with that of other variables within the study model. Whereas there is exists gap in the significance of variables for determining net benefits, these variables have comparable performance. IPMA was developed to identify those predecessors which

present relatively high total effects (importance) and also relatively lower performance for target variables. Importance should be placed on the characteristics of these specific variables, as these may offer prospective grounds for enhancement. With regard to increase of the net benefits, it can be confirmed that the administrative focus must be on enhancing requirements of IS based on system use.



Note: SYQ= system quality, INQ= information quality, SVQ= service quality, SU= system use, UST= user satisfaction

Figure 4: priority map analysis

6. Discussion

This research proposed IS success model in the Sudanese banking industry applying the D&M model, through examining IS success. The findings of study model as shown in table 10, that all the hypotheses except H2, H5, were supported. System quality is shown a significantly associated with system use, therefore, H1 is supported. This finding revealed that the system quality in the banks' IS has a positive direct influence on system use. This indicates that the quality in systems will provide valid and more reliable sources of information for the users of IS, therefore, resulting in their satisfaction. in addition, this result also indicate that if the information system is easy to learn and easy to use, users will use it more Furthermore, this result is consistent with evidence from the prior studies (Montazemi and Qahri-Saremi 2015) and (Salim, Mahmoud et al. 2016). On the other hand, system use is not significant influence user satisfaction, hence, H2 is not supported, this means that the users do not find the beneficial of system enough to support the necessary processes and provide the forms as expected, which making the users feeling dissatisfied with the system. This relationship is in line with (Ofori, Boateng et al. 2017) and (Damabi, Firoozbakht et al. 2018). Our study result confirms that information quality have significant influence system use, which mean, H3 is supported. The significant of this relationship indicates that higher information quality leads to the enhanced system use, which resulting to increase the benefits in general. This result is consistent with (Iivari 2005, Munir and Rahman 2015). Study model found that, information quality significantly associated with user satisfaction, therefore, H4 is supported. This evidence demonstrates that the sufficient and relevant information provided by the banking system, reinforces the user satisfaction. This finding is consistent with (Okechi and Kepeghom 2013). As regards the service quality, we found that the service quality is not significant influence system use; hence, H5 is not supported. Therefore, the department of service should have good understanding and knowledge of the banking system as well as common and potential problems. This result is in line with (Manchanda and Mukherjee 2014). Our finding support that service quality has significant impact on user satisfaction, hence, H6 is supported, this result is consistent with (Stamenkov and Dika 2016) and (Susanto, Lee et al. 2013) , this finding indicates that service quality sufficiently satisfy the needs of user, with indicating to issues regarding speed of responsiveness and accuracy (Floropoulos, Spathis et al. 2010). The results showed that system use is positively related with user satisfaction, therefore H7 is supported. This is in relation with the results reported in prior studies, for example (Petter, DeLone et al. 2008), who listed four studies that found a positive and significant influence of system use on user satisfaction, also (Petter and McLean 2009) conducted a meta-analysis of 26 research, and they found that the relationship between system use and user satisfaction across all studies is significant. On the other hand, this study found that system use is significantly

associated with net benefits, hence H8 is supported. This result indicates that the use of information system makes users feel more familiar with the procedure of input and output, especially if some users do not have adequate knowledge with information systems, this finding is consist with (Borena and Negash 2016). Study findings confirm that user satisfaction is significant influence on net benefits, thus, H9 is supported, this indicates that more user satisfaction will lead to increase job productivity and increased knowledge, thus influence net benefits of using information system directly. This finding is in line with (JAAFREH 2017). According to our study model, net benefits is considered to be a closer of success measure of IS than another success variables. Net benefits must improve if quality measures (system quality, information quality, and service quality), system use, and user satisfaction are properly managed. Sudanese banking industry needs to attentiveness during the improvement steps to system quality, information quality, and service quality in order to effect system use, user satisfaction, and net benefits, which will lead to greater success of information systems.

7. Validated the Study Model and Performance

Figure 5 explain the validated model for success of IS, which presented in section 3. The paths from system quality and information quality towards system use as being significant. However, as explained the path from system quality towards user satisfaction is insignificant. In addition, the path from service quality towards system use is insignificant. However, as shown the paths from information quality and service quality towards user satisfaction is significant. Also, the paths from system use and user satisfaction towards the net benefits as being significant. In other hand, in our findings we found the adjusted R^2 values are slightly better than that reported D&M model (Delone and McLean 2003) in terms of system use and user satisfaction. However, the D&M model offer adequate predictive power for system use and user satisfaction with information system among Sudanese banking industry.

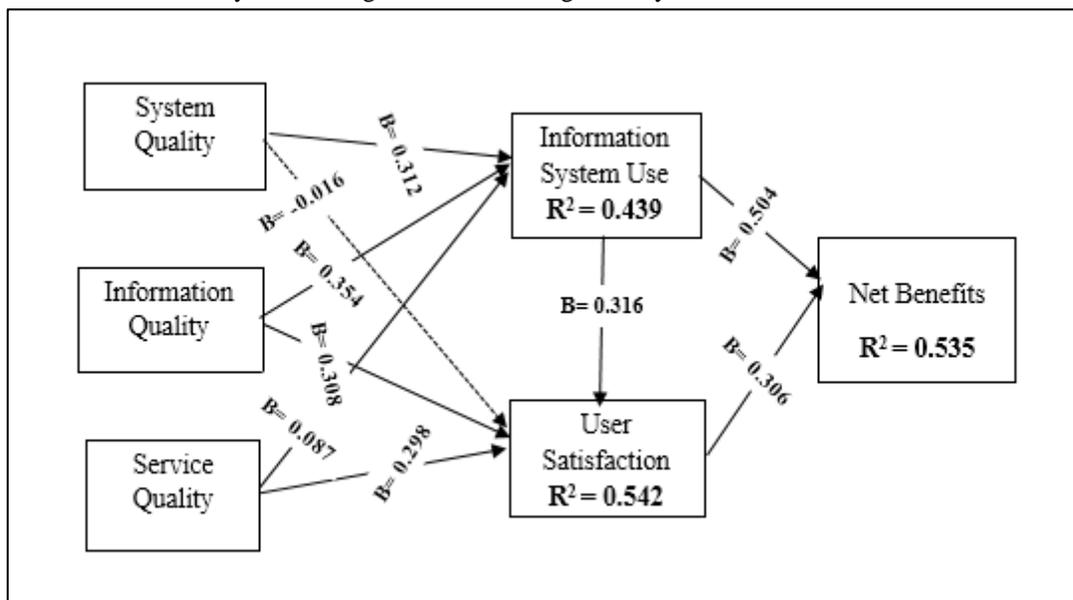


Figure 5. Model illustrating the factors influencing Banking system

8. Conclusion

Technology of banking system represents an important area of interest to be studied and examined especially regarding the difficulties accompanied by adopting such technology. Furthermore, few papers have addressed the associated the success of information system in the banking industry in Sudan. On the other hand, there was a necessity to choose the theoretical basis, which is able to adopt the most significant aspects linked to the success of banking systems by Sudanese banking. Therefore, D&M model was chosen to propose our study model. In more details, this study investigate the relationship between system quality, information quality, and service quality, compared to system use. In addition, we investigate the correlation between system quality, information quality, and service quality related to user satisfaction, then, the association between system use and user satisfaction with net benefits. Research data collected using a questionnaire with participation of 102 actual cases, analyzed by SPSS and techniques of SEM to test the model and hypotheses. Finally, this research contributes to the literature of IS on the success of banking information systems in developing countries with an emerging economy, especially by identifying in a wider measurement method of its efficiency.

9. Limitations and Future Research Directions

This research was carried out to measure the success of adopting IS in the Sudanese banking industry based on D&M Model it is strongly recommended that similar research be conducted to test the applicability of the results of this research to other organizations such as universities, governmental agencies, and telecommunication companies. The different surveying of respondents from companies or other organizations and analysis of the data for further validation of the survey instrument and the research results would be useful to practitioners. This research has offered an examined questionnaire instrument.

Moreover, this paper has applied a model that supported a methodical technique to realize the dimensions that affect IS success in Sudanese banking industry. However, various advantageous areas for future research remain to be explored. For instance, the findings of this research are limited to successful IS in banking industry, Thus, future studies need to consider the factors that lead to the failure of IS. In addition, researchers recommend is to the research model and tools with larger samples, which can lead for a more accurate research of impacts between model variables.

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