An Empirical Test of Information System Success Model in a University's Electronic Services

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ABSTRACT

Background: In order to keep up with the advancement in the educational institutes and compete with developed countries, the universities in developing countries sought to exploit the modern technologies to enhance the work process and delivering better services for students. However, without continuing to use the digital services by the stockholders will lead to the failure of any electronic project as stated by previous literature. In addition, Iraq has witnessed a partial or total failure of many electronic projects such as information sharing project.

Objective: To avoid increasing the failure rate among the electronic projects in the public sector, this paper was harnessed the IS success model for Delone and McLean to highlight the main elements which need more attention by the administration of the universities and the designers through adoption certain electronic services. The quantitative method is the main approach of collecting the raw data from the respondents. The staff who work in particular university in Iraq and have good experience with Information and communications technologies were randomly selected for attaining the purpose of such study. As for the data analysis, the present study used second generation technique (Partial Least Squares) to analyze the self-administration questionnaire as well as use SmartPLS V.3 as an instrument.

Result: The findings confirmed the positive influence of service quality on use and user satisfaction. The results also supported the strong positive influence of use and user satisfaction on net benefit.

Conclusion: This quantitative study can be helpful for universities officials to address the actual challenges related to electronic services implementation and to set proper strategies for implementing futuristic electronic services projects.

KEYWORDS: Post-implementation, IS success model, Iraq University, SEM-PLS

INTRODUCTION

Using Information and communication technologies in the public sector (such as e-services or m-services) has gained increasing global attention in recent years, especially among developed countries, as a mechanism to reduce costs, increase effectiveness and improve public access to governmental services [1][43]. However, according to Faaeq et al. [2] the success of implementation of the electronic services project lies in the resolution of some social issues that can prevent the ICT adoption in the country at a whole. Cristobal et al. [3] stated that, the quality of services or information in any e-initiative which influences whether directly or indirectly on user satisfaction, and therefore influences on performance, this claim also stated by [44]. In the similar context, Ganguli and Roy [4] and Makarem, et al. [5] pointed out that, the transition from face-to-face service to e-service could generate some dissatisfaction to some end users, because not everyone feels free to use an impersonal service, preferring to deal with real people instead of machines.

Currently, the higher education sector in Iraq is an essential part of the country’s effort to develop and
improve system and society. According to Mohammed et al., [8] the higher education sector plays a leading role in securing long-term civic peace and it's trying to make a huge basic of educated society in Iraq. Therefore, in this decade, the education sector is changing [6]. Where, many universities in Iraq (public or private) sought to harness the modern technologies (such as web 2.0, mobile applications) to enhance the interaction between the students and lecturers and smooth the work process. Gikandi, Solomon and Edna [11] confirmed that, the use of e-services in operational processes of teaching and administration can support staff to improve their work performance and promote competitive advantage for the university.

According to Al-Saadi, et al., [7] the education sector in Iraq is pressured to adapt to changes brought about by technological shifts, financial boom and crisis, globalisation, demographic pressures, and most especially changing user expectations. In general, various organizations such as schools, universities, and government organizations can take advantage of electronic services. This argument also supported by Gikandi, et al. [11], who referred that, the establishment of electronic services has been an important policy goal in many universities worldwide. Notwithstanding the importance of e-service implementation in the universities and post-implementation evaluation, we found the scarcity of empirical study, which focused on the phenomenon.

**Motivation Of The Study:**

Although the exploitation of modern technologies in a significant increase in universities [45]; however, it has attracted less attention of researchers and practitioners [10]. Moreover, the number of studies focusing on the use of modern technologies in unstable or conflict areas such as Iraq is limited, as stated by Al-Saadi et al., [7].

In addition, Menezes et al., [9] asserted that, the main problem that the university suffers from providing e-services is the risk of losing the interaction between stakeholders when exchanging face-to-face services for electronic services. Therefore, in order to prevent such risk, it’s important to gain knowledge on factors that can improve user’s satisfaction in e-services, as provided by the institution. Furthermore, Heeks [12] stated that, the e-services ventures in developing countries has seen the proportion of major failures, and will face many challenges in the future that may hinder progress to provide the services if not treated in time. In Iraq many electronic services ventures were stopped after implementation [16], whilst some local government spend large amounts of money for this purpose [17].

With regard to IS success, Iivari [13] asserted that, there is a lack of empirical tests of DeLone and McLean’s model, particularly in the public context. Moreover, Iivari suggests that empirical tests should be done with different types of IS and in different contexts. However, it is important to point out that the implementation, management and evaluation of Information Systems (IS) differ between public and private sector organizations [14]. In fact, public organizations are investing a lot of money in the implementation of different IS, but unfortunately most IS evaluation research focuses on private sector organizations, as stated by Rosaker and Olson [14]. Particularly in Iraq, most of the previous theoretical and practical studies concentrate on the pre-implementation (acceptance) of the e-services in public sectors, while this study aim to assess the e-services in post-implementation.

Additionally, determinants of e-services use have become an increasingly important concern to staff in University [11]. Therefore, there is a need to measure the level of uptake of the e-services implementation as well as identify drivers of such services and their constraints in order to improve them because ICT have the potential to transform higher education. Evaluation electronic services in the university still new topic, particularly in developing country such as Iraq. For that reason, this study provides the first empirical test of the e-services evaluation in educational institutes in Iraq, particular in the Universities. In general, this study aims to evaluate the electronic services from the technical perspective based on updated Delone and Mclean IS success model [15]

**Literature Review:**

**Related works:**

According to Featherman and Pavlou [18] electronic services (aka e-services) are interactive software-based information systems received via the Internet. In the similar vein, Chen et al., [20] stared that, e-services have been emerged with the progress of ICT, especially the Internet and web technologies in the last decade. ICT originally is applied to serve as a means of improving efficiency in the educational process [19]. In this context, several studies discussed exploited ICT in higher education, whether theoretical or practical aspect. Table 1 summarizes these studies.
Table 1: Previous research on ICT and higher education

<table>
<thead>
<tr>
<th>Author (s)</th>
<th>Objective</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vajargah, et al., [21]</td>
<td>The main purpose of this study is focused on the obstacles, facilitators and the risks in using ICT at University level.</td>
<td>This study conducted on one of the Iranian universities. The findings indicated that, there are several challenges pertaining to Information and Communication Technology application, for instance lack of National Policy for using ICT in Higher Education, lack of adequate investments, cultural obstacles, financial challenges, lack of continuity in ICT use, and lack of systematic training and development programs.</td>
</tr>
<tr>
<td>Kunaefi [22]</td>
<td>This paper aims to explain the situation of the ICT use in the universities at Indonesia.</td>
<td>In this paper, the researcher highlighted several open sources application were used by the universities for learning and sharing knowledge among the students and staffs. Moreover, this paper determined the barriers need dealing with it by higher education institutes.</td>
</tr>
<tr>
<td>Shaikh and Khoja [23]</td>
<td>The main objective of the present study is to examine the challenges faced by the Pakistani higher education system (HES) in integrating information and communication technology (ICT)</td>
<td>The study conducted survey with 30 HES experts. The results revealed several issues, such as there is gap in ICT demand and supply, ICT use, ICT-based higher education problems, and reason for delays in ICT integration and provided suggestions for developing ICT-driven HES in Pakistan.</td>
</tr>
<tr>
<td>Makura [24]</td>
<td>This paper aims to investigate students’ perceptions of ICT usage by staff and students at a South African University.</td>
<td>Results based on students’ perspective showed that most lecturers do not use ICT for teaching.</td>
</tr>
<tr>
<td>Wee and Zaitun [25]</td>
<td>The goal of this paper is examined the obstacles toward the use of ICT techniques in teaching information system at Malaysia universities.</td>
<td>The findings of the analysis indicated that, ICT tools are changing too fast to keep current, extra time and effort needed after teaching, network connectivity was poor and the management did not provide any incentive for lecturers to integrate ICT tools in their teaching.</td>
</tr>
</tbody>
</table>

Most of these studies concentrated on the challenges of using ICT in higher education, but few of these selected studies evaluation the post-implementation of e-services in universities.

**Delone and Mclean IS success model:**

Delone and McLean [26] comprehensively reviewed the different IS success measures and concluded with a model of interrelationships between six IS success variable categories: System Quality, Information Quality, IS Use, User Satisfaction, Individual Impact, and Organization Impact, Figure 1 illustrates the initial model.

![DeLone and McLean’s IS Success Model](image)

**Fig. 1: DeLone and McLean’s IS Success Model [26]**

The above model makes two important contributions to the understanding of IS success [27]. First, it provides a scheme for categorizing the multitude of IS success measures that have been used in the literature. Second, it suggests a model of temporal and causal interdependencies between the categories. Since 1992, a number of studies have undertaken empirical investigations of the multidimensional relationships among the measures of IS success (such as Etezadi-Amoli and Farhoomand [28], Goodhue and Thompson [29] and Guimaraes and Igbaria [30]). Similarity, Seddon and Kiew [31] tested part of the DeLone and McLean’s [26]
model through a structural equation model. They replaced Use with Usefulness and added a new variable called User Involvement, and their results partially supported DeLone and McLean’s model.

However, based on the prior studies, DeLone and McLean [15] propose an updated model of IS success by adding “service quality” measures as a new dimension of IS success model and grouping all the “impact” measures into a single impact or benefit category called “net benefit”, as shown in Figure 2.

Fig. 2: updated DeLone and McLean’s IS Success Model [15]

DeLone and McLean [15] contend that Use and Intention to Use are alternative in their model, and that Intention to Use may be worthwhile in the context of mandatory usage. However, staff’s use of electronic systems is fully voluntary and system use is an actual behavior, which has been considered as the variable closer in meaning to success than behavioral intention to use. Thus, this study adopts Use instead of Intention to Use as an electronic systems success measure at university. Figure 3 depicts the research model for this study.

Fig. 3: Research model

According to DeLone and McLean [15], the IS success is a multidimensional and interdependent construct and it is therefore necessary to study the interrelationships among, or to control for, those dimensions. Also, the success model certainly needs further development and validation before it could serve as a basis for the selection of appropriate IS measure. Thus, and based on the discussion stated above, the following nine hypotheses were tested:

**H1**: Information Quality will positively affect Use in the electronic service systems at University context.

**H2**: System Quality will positively affect Use in the electronic service systems at University context.

**H3**: Service Quality will positively affect Use in the electronic service systems at University context.

**H4**: Information Quality will positively affect User Satisfaction in the electronic service systems at University context.

**H5**: System Quality will positively affect User Satisfaction in the electronic service systems at University context.

**H6**: Service Quality will positively affect User Satisfaction in the electronic service systems at University context.

**H7**: Use will positively affect User Satisfaction in the electronic service systems at University context.

**H8**: Use will positively affect Perceived Net Benefit in the electronic service systems at University context.

**H9**: User Satisfaction will positively affect Perceived Net Benefit in the electronic service systems at University context.

**Research Methodology:**

**Instrument and data collection:**
For this study, the researchers adopted a quantitative research design, using a questionnaire survey as their primary means of data collection. In fact, the questionnaire of the present study was developed based on previous literature and was then distributed to a random sample where participation was completely voluntary. Moreover, the purpose of this study is to evaluate the electronic services systems in the higher institutions, the universities in particular.

Furthermore, Sekaran [32] stresses the importance of choosing the questionnaire language that approximates the level of understanding of the respondents. Given that the majority of the employees in the public institutions of Iraq are communicating in the Arabic language, questionnaire items of the study have been translated into the Arabic language. However, the questionnaire was written in both the Arabic and English language. The researchers offered to answer any questions that the respondents might have and to provide further explanation should it be needed. In general, most respondents took less than 15 minutes to complete the questionnaire. A total of 64 sets of questionnaire were returned by the respondents.

The constructs of interest of this study are “Net benefits”, “Information Quality”, “System Quality”, “Service Quality”, “Use” and “User satisfaction”. The theoretical construct was carried out using validated items drawn from prior research. Specifically, the System Quality items were adopted from Wixom and Todd [34]. Service Quality items were adopted from Pitt, Watson and Kavan [33]. Information Quality items were adopted from Bharati and Chaudhury [35]. While, Net Benefit, User Satisfaction and Use items were adopted from Wu & Wang [36]. In addition, all items were measured using a five-point Likert-type scale ranging from “strongly agree” to “strongly disagree”.

Data analysis:

With regard to data analysis, this study used partial least-squares structural equation modelling (PLS-SEM) to analyse the sets of questionnaire that were returned by the respondents. By using the PLS-SEM comprehensive statistical approach, simultaneous evaluation and modification of a conceptual model, including the relationships among the latent variables, is possible [37]. PLS has been widely used for theory testing and validation. According to Fornell and Larcker [38], PLS examines the psychometric properties and provides appropriate evidences on whether relationships might or might not exist. This technique is more suitable for the present study to investigate the factors that might influence electronic service systems in the university. SmartPLS version 3.0 was used to perform the PLS-SEM data analysis. The first step for analysis was to test the content, convergent, and discriminant validate of constructs using the measurement model, while the second step was to test the structural model and hypothesis.

Profile of respondents:

In this study, 53 % (n = 34) of respondents were male and 47 % (n = 30) were female. The level of education of the respondents were categorised into several education groups. 73% of the respondents have bachelor’s degree, while 14% have master’s degree. Moreover, 6% and 6% of the respondents have diploma and PhD respectively. With regard to computer experience, 41% of the respondents have more than 10 years of experience. Moreover, 23% and 36% of the respondents have 4-6 years and 7-9 years of experience respectively.

Assessment of measurement model (Outer model):

The measurement model evaluated the reliability and validity of the constructs. To assess this study, composite reliability, discriminate validity and convergent validity criteria were used [39] [40]. To evaluate the reliability of the reflective measurement model for PLS-SEM, indicator reliability and construct reliability must be assessed, as shown in Figure 3. To evaluate indicator reliability, the loading of each indicator on its associated latent construct was checked. A loading greater than 0.7 is considered acceptable in terms of indicator reliability [41]. All these results were achieved by using PLS Algorithm in SmartPLS.

Fig. 3: Measurement model
Indicators with loadings between 0.4 and 0.7 should be taken out only if deleting the item would result in an increase in the CR or AVE above the indicated threshold value [42]. A Composite Reliability (CR) and Average Variance Extracted (AVE) tests were carried out to measure convergent validity. Fornell and Larcker [38] suggest that the value of CR for each construct must exceed 0.70 while the value of the AVE must exceed 0.50 for the convergent validity to be assured. The CR and AVE values for the constructs included in the study model are all above acceptable levels. These results are presented in Table 2.

Table 2: The results of assessment of the measurement model

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Loading</th>
<th>AVE</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net benefits</td>
<td>Net_Benefit2</td>
<td>0.749</td>
<td>0.612</td>
<td>0.825</td>
</tr>
<tr>
<td></td>
<td>Net_Benefit3</td>
<td>0.770</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Net_Benefit5</td>
<td>0.827</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Quality</td>
<td>Information_Quality1</td>
<td>0.906</td>
<td>0.817</td>
<td>0.899</td>
</tr>
<tr>
<td></td>
<td>Information_Quality4</td>
<td>0.902</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Quality</td>
<td>System_Quality1</td>
<td>0.973</td>
<td>0.802</td>
<td>0.889</td>
</tr>
<tr>
<td></td>
<td>System_Quality4</td>
<td>0.810</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Quality</td>
<td>Service_Quality3</td>
<td>0.714</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service_Quality4</td>
<td>0.835</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service_Quality5</td>
<td>0.855</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service_Quality6</td>
<td>0.756</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>Use1</td>
<td>0.869</td>
<td>0.723</td>
<td>0.839</td>
</tr>
<tr>
<td></td>
<td>Use4</td>
<td>0.831</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User satisfaction</td>
<td>User_Satisfaction1</td>
<td>0.917</td>
<td>0.769</td>
<td>0.869</td>
</tr>
<tr>
<td></td>
<td>User_Satisfaction2</td>
<td>0.834</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As for discriminant validate, it is actually established when the square root of the AVE from the construct is greater than the correlation shared between the construct and other construct in the model (Chin, 1998). Table 3 reports the results of the discriminant validate based on Fornell and Larcker.

Table 3: Discriminant validity of the variable constructs

<table>
<thead>
<tr>
<th>Latent Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Quality</td>
<td>0.904</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net benefits</td>
<td>0.487</td>
<td>0.782</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Quality</td>
<td>0.768</td>
<td>0.574</td>
<td>0.792</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Quality</td>
<td>0.403</td>
<td>0.370</td>
<td>0.407</td>
<td>0.895</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>0.591</td>
<td>0.630</td>
<td>0.705</td>
<td>0.316</td>
<td>0.851</td>
<td></td>
</tr>
<tr>
<td>User satisfaction</td>
<td>0.585</td>
<td>0.461</td>
<td>0.769</td>
<td>0.193</td>
<td>0.473</td>
<td>0.877</td>
</tr>
</tbody>
</table>

Assessment of the structural Model (Inner Model):

In addition to PLS Algorithm, the present study made use of bootstrapping procedure in the SmartPLS 3.0 as shown in Figure 4, where the T values of every path coefficient were produced and subsequently along with the P values as depicted in Table 5.

Table 5: Hypotheses testing results

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Beta</th>
<th>SD</th>
<th>T-value</th>
<th>P-value</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>0.117</td>
<td>0.161</td>
<td>0.730</td>
<td>0.466</td>
<td>Not Support</td>
</tr>
<tr>
<td>H4</td>
<td>0.035</td>
<td>0.103</td>
<td>0.346</td>
<td>0.730</td>
<td>Not Support</td>
</tr>
<tr>
<td>H3</td>
<td>0.605</td>
<td>0.134</td>
<td>4.515</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H6</td>
<td>0.892</td>
<td>0.111</td>
<td>8.023</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H2</td>
<td>0.022</td>
<td>0.118</td>
<td>0.186</td>
<td>0.852</td>
<td>Not Support</td>
</tr>
</tbody>
</table>
The structural model estimation and evaluation of the formulated hypotheses. Results indicated that out of nine of the hypothesis, five of the hypothesis were not supported, namely: H1, H2, H4, H5 and H7, where t-value was 0.730, 0.346, 0.186, 1.111 and 1.169 respectively. The results also indicated that Service Quality have direct effect on use and user satisfaction on the electronic services. Moreover, use and user satisfaction also direct effect on the benefits of the electronic services.

As for R2, as in Table 6, the R2 value for endogenous latent construct (use, user satisfaction and net benefits) demonstrates an acceptable prediction level in empirical research. Where, R2 of key target constructs of the present study has an acceptable value of 0.503, 0.617 and 0.431 respectively. The present study also supports the prior finding through the use of Q2 predictive relevancy measure. Q2 for each of the Net benefit, Use and user satisfaction were 0.228, 0.306 and 0.427 respectively.

Lastly, this empirical study measured the $f^2$ value for supported variables (system quality, service quality, information quality, use and user satisfaction). Table 6 based on the smartpls 3.

### Table 6: Results of $f^2$

<table>
<thead>
<tr>
<th>Construct</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Quality</td>
<td></td>
<td></td>
<td></td>
<td>0.011</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Net Benefits</td>
<td></td>
<td></td>
<td></td>
<td>0.294</td>
<td>0.640</td>
<td></td>
</tr>
<tr>
<td>Service Quality</td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
<td>0.043</td>
<td></td>
</tr>
<tr>
<td>System Quality</td>
<td></td>
<td></td>
<td></td>
<td>0.385</td>
<td>0.022</td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.060</td>
</tr>
<tr>
<td>User Satisfaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In this study, the $f^2$ effect size was examined and the effect sizes of Information Quality -> use and user satisfaction, service quality -> use are found not effect size, whereas system quality -> user satisfaction, use -> user satisfaction, and user satisfaction -> net benefit are found to be small effect size. While, the effect size for service quality -> use was medium. Service quality -> user satisfaction and use -> net benefit are found to be large.

**Discussion And Conclusion:**

Implementing information and communication technologies in the public agencies or organizations will bring many benefits to such institutions. These benefits involve, enhance the work performance, faster task completion, and reducing cost. Despite the importance of the success of e-services systems at universities, where it's success affects the continuity of services. This is less attention by the previous literature on the research of evaluation e-services in universities, particular in developing nations.

Based on this argument and more, it is crucial to investigate the post-implementation e-services system initiatives in university in Iraq. To evaluate the post-implementation e-services, this used the most popular IS success model to assess such systems. DeLone and McLean’s model consists from six constructs, namely: system quality, services quality, information quality, use, user satisfaction and net benefits. This study was conducted in one university in Iraq. This study recruited the employees who work in this university (particular in office) who have good experience with modern technologies. Data were collected mainly through the distribution of a questionnaire among the sixty-four participants.

As for data analysis, the present study exploited the PLS-SEM technique to analyse and interpret the IS success model. In stage one, the reliability and validity of measurement model was presented. In stage two, an examination of the structural model was undertaken by interpreting the path coefficients and identifying the adequacy of the D & M Model. Importantly, the results of the measurement model indicated that all perspective measures were reliable and valid. Furthermore, the results of the structural model analysis indicated that some of the research hypotheses were supported.

The output of this study can serve as a foundation for future research on public sector in general and universities in particular related to post-implementation electronic services systems. In the same time, conceptually, the results of this study sought to enriches literature through shedding light on the factors that effect to continue using the electronic service systems in developing nation, such as Iraq. However, this study as any empirical study also includes several limitations. First, this study focused only of one university in Iraq and also the sampling was small number. Secondly, this study concentrates on the technique aspect only. Thus, in future work directions, we need more studies by researchers on such of context but in different perspective such as social and organizational aspect. In fact, in Iraq the research on implementation of the ICT in the public and private sector still insufficient and not cover all the factors.
REFERENCES


