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Enterprise Resource Planning Systems and User Performance in Higher Education Institutions of Pakistan

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ABSTRACT

The study is designed to assess the impact of Enterprise Resource Planning (ERP) systems on the performance perceived by users in Higher Education Institutions (HEIs) of Pakistan. This study sought to evaluate the effect of ERPs quality factors including Information Quality (IQ), System Quality (SQ) and Service Quality (SRQ) on User Performance (UP) towards system usage through the role of Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and User Satisfaction (US). Consequently, a framework is proposed by integration of DeLone & McLean (D&M) Information Systems (IS) success model and Technology Acceptance Model (TAM) to address the research questions. The study used quantitative research methodology and data were collected from 317 employees from eight universities in Pakistan. Structural Equation Modelling (SEM) was performed using SmartPLS. The results indicated that SQ, IQ and SRQ has direct and positive effect on UP, PU, PEOU and US. Additionally, PU, PEOU and US are found to have influence on UP. Theoretically, the study contributes by integrating factors from D&M IS success model and TAM to investigate the effect of ERP systems on UP through PU, PEOU and US. Practically, the study implied that practitioners needs to put efforts to provide a system which users perceive as useful and free of efforts.

Keywords
Information Systems, ERP Systems, User Performance, Management Information Systems, Higher Education

JEL Classification
C32, C38, C52, C58

1. Introduction

The term Enterprise Resource Planning (ERP) was introduced by Gartner Group in 1990s (Arif *et al.*, 2004), comprising of "computer software systems that integrate all related processes within enterprise and provides users with services to manage all functions" (Swartz *et al.*, 2001). ERP systems implementation brings great advantages (Ullah *et al.*, 2018; Umar *et al.*, 2016), but due to the uncertainties of technological complexities, the completion of these projects remains a challenge (Xu *et al.*, 2010). Millions of dollars are invested on ERP systems (Beheshti *et al.*, 2010), and despite of enormous growth, it is claimed that these systems failed

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with a higher rate of about to be 60 -90 percent (Ahmad *et al.*, 2014; AlShamlan *et al.*, 2011; Gill *et al.*, 2020). Similarly, it is reported that the organization's expenditure on ERP systems implementation is about $6.1 million, of which 58% are cost overrun, 65% experienced schedule overrun, and in the post implementation stage 53% achieved less than 50-percent of anticipated measurable benefits (Solutions, 2015). Thus, making this a thorny problem deserving further exploration that how to achieve related outcome from implemented systems (Sun *et al.*, 2015).

In the IS related research, assessing its impact is a crucial concern (Petter *et al.*, 2008) and it is repeatedly reported as the main problem by organizational administrators (Gable *et al.*, 2008). Practitioners as well as researchers yet to find answers for how to measure IS successfully (Rabaa'i *et al.*, 2009). In this quest, several models and theories have emerged to measure and recognize technology and specifically IS such as, the Social Cognitive Theory (Bandura, 1986), D&M IS success model (DeLone *et al.*, 1992, 2003), Theory of Reasoned Action (TRA), Diffusion of Innovation (DOI) theory (Rogers, 1995), Theory of Planned Behavior, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2003), TAM (Davis, 1989). However, with the continues innovation in technologies, the focus is shifted towards the outcome in terms of performance while evaluating system success (A. H. Aldholay *et al.*, 2018; Isaac *et al.*, 2017).

Within the ERP environment, previous studies mentioned performance evaluation of these systems and only some of the reported articles discussed its impact on the productivity and performance (Shen *et al.*, 2016). Reviewing the literature related to ERP system performance shows that majority of prior studies measure the ERP systems in terms of performance at organizational level rather than individual and the outcome variables discussed are product quality (Banker *et al.*, 2006), benefits (Zhu *et al.*, 2010), financial performance (Ayman *et al.*, 2015), organizational service enhancement (Gorla *et al.*, 2010), market value (Ranganathan *et al.*, 2006), process efficiency (Chou *et al.*, 2008), shareholder return (Galy *et al.*, 2014), competitive advantage (Ram *et al.*, 2014), organisational benefits (Almahamid *et al.*, 2015). Thus, providing enough evidence to investigate from users perspective at individual level rather organizational level, that is investigating the actual impacts of ERP systems on users (Hsu *et al.*, 2015), as users itself are consumers while receiving services from IT department (Alsaleh *et al.*, 2016) and user performance studies are given less attention (Ullah, Baharun, Nor, Siddique, & Sami, 2018). Although, ERP systems have implemented in large manufacturing organizations, but research in higher education is still limited (Albarghouthi *et al.*, 2020), especially in Pakistan (Ahmer *et al.*, 2018; Nizamani *et al.*, 2014).

In summary, the preceding background presents the motivation for the research, and it shows that studies tested these models in different areas with different stakeholders and systems. Some studies adopted these models partially and tested specific constructs, while others tried to extend the models by adding additional constructs. Keeping in view the above,

D & M model and TAM integration is another route to evaluate antecedents that determine the ERP systems success in higher education of Pakistan. Accordingly, objective of the study to propose a model based on D & M IS success model representing quality factors and TAM to examine whether quality factors as antecedents to acceptance and user satisfaction effect user performance while using ERP system.

2. Literature review and development of hypotheses

2.1 System quality

In related literature to IS, quality is somewhat "ill-defined" (Nelson *et al.*, 2005) and debate exists among authors that the quality factors are either self-defined or derived empirically (Ullah, Baharun, Nor, Siddique, & Bhatti, 2018). Rai *et al.* (2002) defined, System Quality as "the degree to which a system is user friendly". System quality is often found relevant construct and always found in support, while evaluating the matters of IS (Urbach *et al.*, 2010) and is studied widely as explanatory construct in ERP research (Gorla *et al.*, 2010; Rajan *et al.*, 2015; Sternad *et al.*, 2013).

In studies, positive impact of SQ on perceived usefulness has been found. Among them Lin (2010) found the influence of SQ on PU and the study also indicated that SQ can increase the belief about ERP system usefulness. Zhou (2014) investigated system quality influence on perceived usefulness to measure trust in mobile payment and found the effect significant. This relationship is also found positive in other related studies of the ERP system environment (Abugabah *et al.*, 2015; Ali *et al.*, 2013; Cheng, 2019; Gorla *et al.*, 2014; Lin, 2010; Tseng *et al.*, 2018; Yang *et al.*, 2017; Zhou, 2011). In their study on ERP satisfaction and user adoption Costa *et al.* (2016) found that SQ have positive effect on perceived ease of use. Other related studies also tested and confirmed the effect of SQ on PEOU (Abugabah *et al.*, 2015; Ali *et al.*, 2013; Lin, 2010; Rana *et al.*, 2015; Yang *et al.*, 2017).

Satisfied ERP employees may be more efficient, when system usage is mandatory (Hsu *et al.*, 2015) as US refers to "the degree to which users believe that the IS meets their requirements" (Delone *et al.*, 2003). According to Tsai *et al.* (2012) SQ is the key antecedent of user satisfaction in ERP environment. Therefore, we expect that the SQ has a significant influence on US. Prior studies backed this claim and showed significant effect of SQ on US such as (Cheng, 2019; Costa *et al.*, 2016; Landrum *et al.*, 2010; Lin, 2010; Masrek *et al.*, 2016; Noorman Masrek *et al.*, 2010; Rana *et al.*, 2015; Shahibi *et al.*, 2016; Tam *et al.*, 2016). Based on these pieces of evidence, it is postulated that:

H1: System quality positively influence perceived usefulness
H2: System quality positively influence perceived ease of use
H3: System quality positively influence user satisfaction

2.2 Information quality

Information Quality (IQ) is "the degree to which information generated possess content, accuracy, and format" (Rai *et al.*, 2002). Higher information quality enhances performance of users with system usage, reinforcing the perceptions of usefulness (Chen *et al.*, 2015). Researchers supported the effect of information quality on perceived usefulness like (Abugabah *et al.*, 2015); Floropoulos *et al.* (2010). In similar environment Zhou (2011) found the positive effect of IQ on PU in the study of mobile web sites adoption. Other researchers (Alfarraj *et al.*, 2017; Chen *et al.*, 2015; Cheng, 2019; Lin, 2010; Tseng *et al.*, 2018; E. S.-T. Wang, 2016; Zhou, 2014) also confirmed this effect. The effect of information quality on perceived ease of use was found by the study of Ali *et al.* (2013) while evaluating IS impact on user performance. Their result confirmed that user performance is improved when system is useful and easy to use. This relationship is also explored in studies of (Abugabah *et al.*, 2015; Rana *et al.*, 2015; Zhou, 2011) in different settings.

Information quality plays a vital role to satisfy users to achieve goals and it depends on the purpose of the users (Y. S. Wang, 2008). Mohammadi (2015a) tested the influence of IQ on user satisfaction to investigate user's perceptions about e-learning system in universities and found this relationship significant. Moreover, previous researchers found that IQ is a key predictor of user satisfaction (Chen *et al.*, 2015; Cheng, 2019; Floropoulos *et al.*, 2010; Hsu *et al.*, 2015; Landrum *et al.*, 2010; Lin, 2010; Masrek *et al.*, 2016; Mohammadi, 2015b; Noorman Masrek *et al.*, 2010; Shahibi *et al.*, 2016; Tam *et al.*, 2016). These studies showed that satisfaction of users with the system depends on higher quality of information. Hence, it is assumed that:

H4: Information quality positively influence perceived usefulness
H5: Information quality positively influence perceived ease of use
H6: information quality positively influence user satisfaction

2.3 Service quality

Petter *et al.* (2009) described service quality as "the quality of support received by users when interacting with the system". SRQ is treated as peripheral to SQ and IQ, but recent research claimed that it can be seen as substantial construct due to the improved development in the service role of IS (Mohammadi, 2015a). In previous literature, the influence of service quality on perceived usefulness is confirmed as positive (Ahn *et al.*, 2007; Chen *et al.*, 2015; Floropoulos *et al.*, 2010; Landrum *et al.*, 2010; Yang *et al.*, 2017). In a study by Zhou (2011), it is found that SRQ is a predictor to perceived ease of use and this relationship is also confirmed by Ahn *et al.* (2007).

The relationship of service quality with user satisfaction came from Delone *et al.* (2003). The same relationship was tested by Masrek *et al.* (2016) to investigate the determinant of US.

In ERP related studies, several authors (Alshibly, 2014; Hsu *et al.*, 2015; Landrum *et al.*, 2010; Mohammadi, 2015a; Noorman Masrek *et al.*, 2010; Rana *et al.*, 2015; Shahibi *et al.*, 2016; Tam *et al.*, 2016) confirmed the effect of SRQ on US. Thus, SRQ is assumed to have the same effect:

H7: Service quality positively influence perceived usefulness
H8: Service quality positively influence perceived ease of use
H9: Service quality positively influence user satisfaction

2.4 Relationship between PU, PEOU, US to user performance

The constructs perceived usefulness and perceived ease of use came from TAM and this part represents the acceptance of technology. PU and PEOU of TAM are important elements to decide the acceptance of technology of the system (Hsieh *et al.*, 2013). The success of the system also relies on satisfaction level towards the system (Y.-S. Wang *et al.*, 2008). Several studies supported these relationships, for example, Abugabah *et al.* (2015) confirmed that PU influences the performance of users. The same relationship have been found positive and significant in studies by (Ali *et al.*, 2013; Chen *et al.*, 2015). Similarly, the effect of PEOU on user performance in an ERP environment was also found in studies (Abugabah *et al.*, 2015; Ali *et al.*, 2013). Lastly, the influence of user satisfaction on the UP is confirmed positive and significant in previous studies (Chen *et al.*, 2015; Hsu *et al.*, 2015; Noorman Masrek *et al.*, 2010; Tam *et al.*, 2016). Based on the preceding paragraph, the same outcome is expected. Hence the following is postulated.

H10: Perceived usefulness positively influence user performance
H11: Perceived ease of use positively influence user performance
H12: User satisfaction positively influence user performance

2.5 User performance

Scholars used Organizational impact (Gorla *et al.*, 2014), individual impact (Ifinedo *et al.*, 2010), system usage (Lin, 2010), satisfaction (Floropoulos *et al.*, 2010; Landrum *et al.*, 2010), organizational performance (Choi *et al.*, 2013), perceived net benefits (Chen *et al.*, 2015) as dependable variable to measure ERP systems. However, with growth in technology, the focus is diverted to the outcome as performance to measure the success (Abugabah *et al.*, 2015; A. Aldholay *et al.*, 2018; Montesdioca *et al.*, 2015). User performance is referred to the outcome of doing a set of tasks (Alfarraj *et al.*, 2017; Ali *et al.*, 2013; Ullah *et al.*, 2018). In this study, user performance is measured with questions related to efficiency and effectiveness. According to Abugabah *et al.* (2015) efficiency is "the extent to which the method of performance minimizes the efforts that are required to perform the task", and the effectiveness is "the degree of the objective accomplishment showing how well a set of results could be accomplished". In this study context, users are individuals who use ERP system for daily job, have some

knowledge about the functionality of the system, and are familiar with other users (Liu *et al.*, 2011).

3 Research methods

3.1 Overview of proposed framework

In the current study, the constructs and the hypothesized relationships among them are derived from the literature as preceding sections. The framework is shown in Figure 1, where it is mentioned that the ERP quality factors (System quality, Information quality, Service quality) influence perceived usefulness, perceived ease of use and user satisfaction, which further predict user performance. The quality factors are derived from Delone *et al.* (2003), perceived usefulness and perceived ease of use from Davis (1989) and user performance is taken from Abugabah *et al.* (2015). The proposed framework set to test 12 hypotheses.

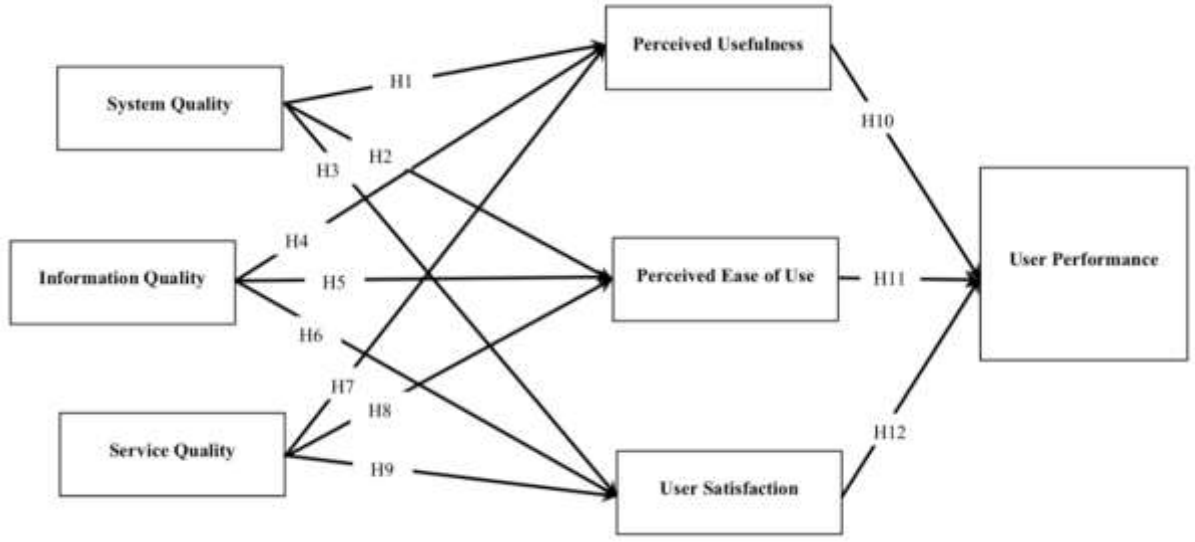

Figure 1: Study Framework

3.2 Development of instrument

In line with existing literature, a total of 51 items questionnaire was developed to capture the constructs. A 5-point Likert scale is employed for each item of the constructs, with 1 as strongly disagree, 5 strongly agree, and 3 as not applicable (NA). All the items in the questionnaire are adapted from related studies as shown in Table 1 and Appendix B.

Table 1: Construct measurement

Construct	Items	Source
System Quality	SQ1 – SQ9	(Hsu *et al.*, 2015); (Gable *et al.*, 2008); (Nelson *et al.*, 2005)
Information Quality	IQ1 – IQ6	(Hsu *et al.*, 2015); (Gable *et al.*, 2008); (Nelson *et al.*, 2005)
Service Quality		
Reliability	SRQ1 – SRQ4	
Responsiveness	SRQ5 – SRQ7	(Hsu *et al.*, 2015); (Pitt *et al.*, 1995);
Assurance	SRQ8 – SRQ11	(Parasuraman *et al.*, 1988)
Empathy	SRQ12 – SRQ15	
Perceived Usefulness	PU1 – PU4	(Abugabah *et al.*, 2015)
Perceived Ease of Use	PEOU1 – PEOU4	(Abugabah *et al.*, 2015)
User Satisfaction	US1 – US3	(Lin, 2010)
User Performance	UP1 – UP10	(Abugabah *et al.*, 2015)

4 Data collection

As discussed, the instruments for this study are adapted from established sources but pretesting is still needed to ensure that each question fits well with a different set of respondents (Kumar *et al.*, 2013). The process of pretesting was conducted by a panel comprising of renowned academicians in the field. Each questionnaire item was examined, and cases of ambiguous wording are rectified and rephrased. This process fine-tunes the research instrument based on their feedback and recommendations such as tangibility dimension of service quality was removed as most of the questions remained similar to system quality.

Hereafter, the data was collected through google form. The questionnaire was sent by email to all employees in 8 universities in Pakistan. The respondents are ERP system users with the name of Campus Management Solutions (CMS) system. In total, we collected 356 responses from 8 universities. After the completion of initial data screening including missing values and outlier a total of 317 usable sample were retained. The respondents' demography is presented in Table 2.

Table 2: Respondents demographics

Demographic	Feature	Frequency	Percentage
Gender	Male	247	77.9
	Female	70	22.1
Age	Above 21 and below 25 years	18	5.7
	Above 25 and below 30 years	38	12.0
	Above 30 and below 35 years	107	33.8
	Above 35 and below 40 years	61	19.2
	40 and above	93	29.3
Education	Higher Secondary School Certificate (HSSC)	3	0.9
	Graduation (14 years)	10	3.2
	Master (16 years)	45	14.2
	MPhil/MS (18 years)	131	41.3

	Doctorate	128	40.4
Experience	Less than 3 years	61	19.2
	3 to 6 years	78	24.6
	7 to 10 years	78	24.6
	More than 10 years	100	31.5
Usage	Once a week	74	23.3
	Once a day	69	21.8
	Several times a day	51	16.1
	Regular use, many times a day	123	38.8

5 Data analysis and results

Structure Equation Model (SEM) technique was used for hypotheses testing. Two-stage approach was followed as recommended by Hair *et al.* (2017) to examine the measurement model and structural model using SmartPLS 3.0 software (C. Ringle *et al.*, 2015; C. M. Ringle *et al.*, 2020).

5.1 Measurement model assessment

The measurement model stage determines the reliability and validity of the constructs. This includes convergent, discriminant validity and reliability. Convergent Validity is "the degree to which a measure correlates positively with alternative measures of the same construct" (Hair *et al.*, 2017). For factors loading the recommended value is ≥ 0.708 but loading greater than 0.6 or 0.5 is adequate (Ramayah *et al.*, 2018). On the basis of analysis 7 items found to be short of the required level are deleted. The values of composite reliability (CR) shown in Table 3 were used for construct reliability. As shown CR ranging between 0.796 and 0.929 are over the recommended value of 0.70 by Gefen *et al.* (2000); Kline (2010). Average Variance Extracted (AVE) criterion was employed to determine convergent validity. AVE ranging between 0.602 and 0.711, meeting the recommended threshold above 0.50 (Hair *et al.*, 2010).

Table 3: Reliability and loading

Construct	Item	Loading (>0.5)	CR	AVE
System quality (SQ)	SQ2	0.686	0.896	0.612
	SQ3	0.777		
	SQ4	0.791		
	SQ5	0.781		
	SQ6	0.650		
	SQ8	0.727		
	SQ9	0.785		
Information quality (IQ)	IQ1	0.776	0.929	0.685
	IQ2	0.819		
	IQ3	0.849		
	IQ4	0.874		
	IQ5	0.851		
	IQ6	0.794		
Service quality (SRQ)				
Reliability (REL)	SRQ1	0.662	0.796	0.610

	SRQ2	0.750		
	SRQ3	0.837		
Responsive (RESP)	SRQ5	0.813	0.872	0.694
	SRQ6	0.864		
	SRQ7	0.821		
Assurance (ASSU)	SRQ9	0.693	0.810	0.602
	SRQ10	0.802		
	SRQ11	0.802		
Empathy (EMP)	SRQ12	0.740	0.832	0.624
	SRQ13	0.779		
	SRQ14	0.847		
Perceived usefulness (PU)	PU1	0.813	0.908	0.711
	PU2	0.841		
	PU3	0.880		
	PU4	0.836		
Perceived ease of use (PEOU)	PEOU1	0.686	0.838	0.620
	PEOU2	0.621		
	PEOU3	0.860		
	PEOU4	0.820		
User satisfaction (US)	US1	0.843	0.829	0.618
	US2	0.721		
	US3	0.789		
User performance (UP)	UP1	0.723	0.874	0.650
	UP2	0.612		
	UP3	0.704		
	UP4	0.580		
	UP5	0.798		
	UP6	0.676		
	UP7	0.724		
	UP8	0.655		

All loadings are statistically significant ($p<0.01$)

Discriminant validity is "the extent to which a construct differs from other constructs in the research model, that is the construct measures what is intended to measure" (Hair *et al.*, 2017). Discriminant validity was determined using three criteria namely Fornell and Lacker's criterion (Fornell *et al.*, 1981), items cross loading and recently developed Heterotrait-Monotrait Ratio (HTMT) (Henseler *et al.*, 2015). Fornell-Larcker's criterion is the comparison of square root of AVE values with construct correlations (Hair *et al.*, 2017), in other words, the construct share more variance with its own block of items compare to other construct. Table 4 presents discriminant validity using this criterion is established as the values of each construct's square root (values presented in bold) are larger than the correlation value between construct.

Table 4: Fornell-Larcker's criterion

	ASSU	EMP	IQ	PEOU	PU	REL	RESP	SQ	UP	US
ASSU	**0.776**									
EMP	0.512	**0.790**								
IQ	0.495	0.519	**0.828**							
PEOU	0.518	0.542	0.642	**0.787**						
PU	0.462	0.312	0.504	0.542	**0.843**					
REL	0.592	0.496	0.509	0.303	0.461	**0.781**				
RESP	0.517	0.527	0.407	0.430	0.447	0.578	**0.833**			
SQ	0.584	0.557	0.434	0.417	0.428	0.524	0.530	**0.782**		
UP	0.557	0.435	0.420	0.532	0.320	0.506	0.429	0.334	**0.806**	
US	0.582	0.550	0.462	0.320	0.416	0.538	0.544	0.320	0.548	**0.786**

The second approach is cross loading, "that is outer loading of each indicator on the associated construct should be higher than the cross loadings on the other construct" (Hair et al., 2017). As shown in Appendix A the values of the indicators have loaded highly on their respected construct. Thus, providing adequate evidence of fulfilling the convergent validity requirement.

5.2 Structural model assessment

As per Hair *et al.* (2017) the structure model assessment includes: assessment of collinearity by evaluating the predictor constructs, assessing the significance and relevance of the path coefficients representing hypotheses among constructs, coefficient of determination (R^2), effect size (f^2), and assess the predictive relevance (Q^2). For this study, SRQ construct is Higher Order Construct (HOC) with 4 sub-dimensions. HOC assessment is necessary to determine whether their first order (lower order) constructs load onto their respective second order (higher order) construct. To achieve HOC assessment, the researcher employed the two stage higher order construct modeling approach by (Becker *et al.*, 2012; C. M. Ringle *et al.*, 2012; Wilson, 2010). The first stage is repeated indicator approach. In this approach HOC's measurement model is represented by assigning all the indicators of the first order construct to the HOC. The second stage is using latent variable scores as indicator representing the first order construct in the final structural model (Hair *et al.*, 2017). The PLS-SEM produced latent variable scores for each construct and saved for further analysis.

5.2.1 Hypotheses tests

Table 5 gives the hypothesized direct relationships results. Specifically, SQ ($\beta = 0.474$, $t = 7.797$, $p < 0.01$) has significance influence on PU. Similarly, SQ has significance relationship with PEOU ($\beta = 0.381$, $t = 6.388$, $p < 0.01$) and the results further confirmed the positive relationship between SQ and US ($\beta = 0.396$, $t = 6.740$, $p < 0.01$). Thus, providing support for H1, H2 and H3. Furthermore, IQ has significance influence on PU ($\beta = 0.131$, $t = 3.124$, $p < 0.01$), PEOU ($\beta = 0.227$, $t = 4.441$, $p < 0.01$) and US ($\beta = 0.219$, $t = 4.302$, $p < 0.01$). Therefore, H4, H5 and H6 are supported. Figure 2 shows structural model assessment.

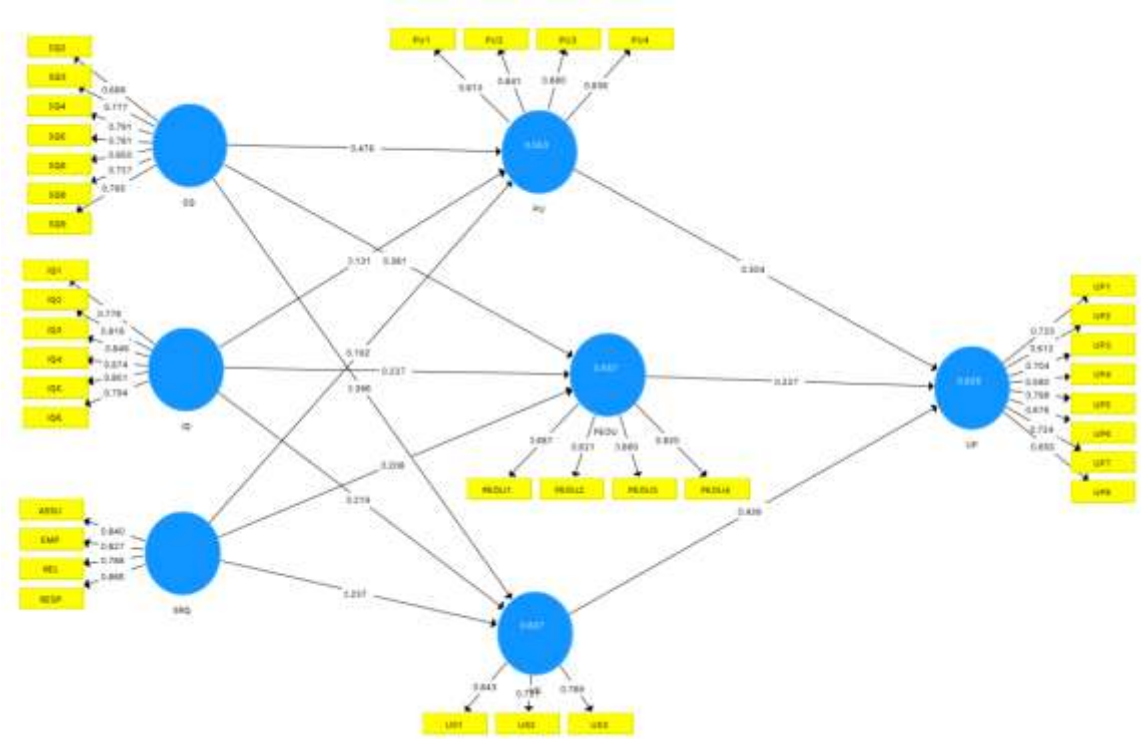

Figure 2: PLS Algorithm of structural model

Likewise, SRQ has positive and significance relationship with PU (β = 0.192, t = 3.017, p< 0.01), PEOU (β = 0.208, t = 3.546, p< 0.01) and US (β = 0.237, t = 3.933, p< 0.01). Hence, providing enough evidence to support hypotheses H7, H8, and H9. The results provide further indication that PU (β = 0.304, t = 9.760, p< 0.01) exhibits positive and significance influence on UP. In addition, PEOU (β = 0.227, t = 3.555, p< 0.01) has positive and significance effect on UP. Lastly, US (β = 0.439, t = 7.566, p< 0.01) shows significance effect on UP. Therefore, hypotheses H10, H11, and H12 are supported.

Based on the Table 5, R^2 value (0.826) for user performance imply that the combination of constructs: system quality, information quality, service quality, perceived usefulness, perceived ease of use and user satisfaction explain 82% of the variance in user performance. Similarly, system quality, Information quality and service quality jointly contribute 55% variance in perceived usefulness. The same set of predictors i.e. SQ, IQ, SRQ account for 56% and 60% variance in perceived ease of use and user satisfaction respectively. In conclusion, as per the recommendation of Chin (1998) the results shows that the predictive values for user performance can be considered as substantial, while perceived usefulness, perceived ease of use and user satisfaction qualify as moderate.

Table 5: Summary of results of hypotheses

Hyp.	Path	(β)	SE	T value	P Value	Decision	R^2	f^2	Q^2
H1	SQ -> PU	0.476	0.061	7.797	0.000	Supported	0.553	0.133	0.360
H2	SQ -> PEOU	0.381	0.060	6.388	0.000	Supported	0.557	0.086	0.289
H3	SQ -> US	0.396	0.059	6.740	0.000	Supported	0.607	0.105	0.347
H4	IQ -> PU	0.131	0.042	3.124	0.001	Supported		0.017	
H5	IQ -> PEOU	0.227	0.051	4.441	0.000	Supported		0.053	
H6	IQ -> US	0.219	0.051	4.302	0.000	Supported		0.055	
H7	SRQ -> PU	0.192	0.064	3.017	0.001	Supported		0.028	
H8	SRQ -> PEOU	0.208	0.059	3.546	0.000	Supported		0.033	
H9	SRQ -> US	0.237	0.060	3.933	0.000	Supported		0.048	
H10	PU -> UP	0.304	0.031	9.760	0.000	Supported	0.826	0.208	0.345
H11	PEOU -> UP	0.227	0.064	3.555	0.000	Supported		0.032	
H12	US -> UP	0.439	0.058	7.566	0.000	Supported		0.140	

Note: $p<0.01$

The effect size (f^2) for the study is also assessed. The effect size (f^2) is "a measure used to assess the relative impact of a predictor construct on an endogenous construct" (Cohen, 1988). The results in Table 5 indicate that SQ has medium effects on PU (0.133), small effect on PEOU (0.086), and US (0.102). Information quality has small effects on PU (0.017) PEOU (0.053), US (0.055). Similarly, service quality exhibited small effect on PU (0.028), PEOU (0.033), and US (0.048). The result also indicated that the effect of PU on UP (0.208) is medium. Lastly, PEOU (0.032) and US (0.140) has small effect on UP.

In terms of predictive relevance, the blindfolding procedure was employed to measure predictive relevance. Predictive relevance (Q^2) represents "how well the data collected empirically can be reconstructed with the help of the model and the PLS parameters" (Fornell *et al.*, 1994). As per Ramayah *et al.* (2018) and Hair *et al.* (2017) the recommended Q^2 value should be larger than zero for dependent construct in structural model. The recommended Q^2 values of 0.02 (small), 0.15 (medium) and 0.35 (large) indicate the level of predictive relevance for endogenous construct (Hair *et al.*, 2017). Table 5 presents that the Q^2 values for all endogenous constructs are above zero, clearly indicate that the model has predictive relevance. Thus, the result shows that one endogenous variable has a large effect and the remaining have medium predictive relevance.

6 Discussions

The aim of the study is to evaluate the effect of quality factors on user performance. On integration of D&M IS success model and TAM, the study proposes and tests a framework. The result revealed that system quality positively effect perceived usefulness, perceived ease of use and user satisfaction. The effect of SQ on perceived usefulness (H1) is found significant and in line with studies of (Alfarraj *et al.*, 2017; Ali *et al.*, 2013; Cheng, 2019; Gorla *et al.*, 2010; Lin, 2010; Tseng *et al.*, 2018; Zhou, 2011, 2014). H2 is found supported, postulated as SQ positively effect PEOU. This relationship provides further support to the previous studies (Costa *et al.*, 2016; Rana *et al.*, 2015; Yang *et al.*, 2017; Zhou, 2011). Another hypothesis as the effect on SQ on US (H3), was found supported and consistent with prior research in similar

context (Cheng, 2019; Masrek *et al.*, 2016; Ojo, 2017; Tam *et al.*, 2016). This imply that SQ is important antecedent to the perception of usefulness, ease of use and satisfaction. In this study context, system accuracy, system easiness, easy to learn are important considerations for users to perceive the system as useful, free of efforts and be satisfied.

With regards to information quality relationships with PU, PEOU and US, three hypotheses H4, H5, H6 were tested. Consistent with previous research the influence of information quality on perceived usefulness (Alfarraj *et al.*, 2017; Chen *et al.*, 2015), perceived ease of use (Abugabah *et al.*, 2015; Rana *et al.*, 2015; Zhou, 2011) and user satisfaction (Chatterjee *et al.*, 2018; Cheng, 2019; Hsu *et al.*, 2015; Lin, 2010; Masrek *et al.*, 2016; Sharma *et al.*, 2019; Tam *et al.*, 2016; Urbach *et al.*, 2010) is confirmed. In this study context in higher education, users find the system as useful, ease of use when the obtained information from the system are clear, readable, well formatted and concise. Higher quality of information increases the satisfaction with the system by balancing the system output and user requirements.

The relationship of service quality with perceived usefulness, perceived ease of use and user satisfaction were postulated as hypotheses H7, H8, H9 and found supported. The result supported the effect of SRQ on PU and confirmed the findings of (Ahn *et al.*, 2007; Chen *et al.*, 2015; Floropoulos *et al.*, 2010; Landrum *et al.*, 2010; Yang *et al.*, 2017; Zhou, 2011). This imply that SRQ is key antecedent to PU. When users get high quality service from support staff, then the system is perceived as more useful. Similarly, in line with the studies of (Ahn *et al.*, 2007; Lin, 2015) the result shows that SRQ has positive influence on PEOU. The system is perceived to be free of efforts when IT staff provide timely service, shows sincere efforts to solve their problems, and the services are reliable and error free. Moreover, the users will find the system as ease of use when IT staff boost their confidence, feels safe while dealing with IT staff, find the IT staff knowledgeable, and IT staff provide them individual attention.

The result also reveals that SRQ has significant influence on user satisfaction. As expected the result supported previous studies (Floropoulos *et al.*, 2010; Hsu *et al.*, 2015; Landrum *et al.*, 2010; Masrek *et al.*, 2016; Mohammadi, 2015a; Noorman Masrek *et al.*, 2010; Rana *et al.*, 2015; Sharma *et al.*, 2019; Tam *et al.*, 2016). The findings imply that service quality strongly contributes to the satisfaction level of users upon providing services to them. In this study context, when the services provided by IT staff are reliable, timely and boost confidence to them, then users feel satisfaction with the system.

This study also tested the effect of perceived usefulness, perceived ease of use and user satisfaction as antecedents to user performance and postulated as H10, H11, and H12. Consistent with the previous work (Abugabah *et al.*, 2015; Ali *et al.*, 2013; Chen *et al.*, 2015), the effect of PU on user performance is confirmed. The result shows that PU is strong proxy for user performance, that is the perception of the system's usefulness in terms of job performance. In the same vein the effect of perceived ease of use on UP is confirmed and

implies that the system perceived as free of efforts have impact on the performance on users. Lastly, the findings confirmed the significant influence of user satisfaction on user performance. Previously, positive effect of US on user performance was found in literature (A. H. Aldholay *et al.*, 2018; Choi *et al.*, 2013; Noorman Masrek *et al.*, 2010). This implies that user satisfaction is a key factor of user performance, as satisfied users with the system leads to better performance.

7 Theoretical implications

From the theoretical angle, this work provides several contributions in ERP system area. The first contribution is to bring together the quality factors of D&M IS success model and confirmed that each have effect on perceived usefulness, perceived ease of use and user satisfaction. Although, service quality has been part of updated D&M IS success model since 2003 but most of the research focuses on the relationships of SQ and IQ with different constructs to measure system success. In current study service quality is used to captures user's assessment of services delivered by IT staff as they collect holistic view of service quality while interacting with them.

Second, the study incorporates perceived usefulness, perceived ease of use and user satisfaction. In ERP systems evaluation studies these effects are tested singularly or in combination involving other antecedents. Thus, according to researcher knowledge, this is the first empirical work to measure the impact of the ERP systems on through PU, PEOU and US in a framework involving SQ, IQ, and SRQ as their antecedents. This confirms the importance of TAM as PU and PEOU facilitates user performance in the presence of quality factors in this study context. Hence, incorporating ERP quality factors of D&M IS success model with PU and PEOU of TAM can capture complete picture to evaluate ERP system.

Contextually, the work generally contributes to the body of knowledge on user performance and particularly to higher education from the perspective of users. Mostly, in higher education the focus remained on technical aspects of the systems. Thus, the study contributes to literature on higher education, especially higher education of Pakistan.

8 Practical implications

In terms of practical contribution, one of the implications is the establishment that perceived usefulness and perceived ease of use were shown vital impact on user performance. This shows that users put emphasis on usefulness and easy to use. This provides practitioners the opportunity to help users to realize the benefits of the system with regards to usefulness and ease of use. Therefore, the practitioners need to put efforts to provide a system which user perceive as useful and free of efforts, that is to produce a system that make their job easy, to enhance their productivity, easy to use, easy to learn, understandable.

In case of user satisfaction, it can be concluded that US plays the role between the relationship of system quality and information quality and service quality with user performance. Hence, the practitioners need to ensure that users are satisfied with the functional features, output of the system and services provided to them. Another major conclusion is that among all quality predictors the results suggest that system quality is having great impact. The possible conclusion is that users place more emphasis on system quality which represent functional features of the system. The practitioners need to put efforts on the functional features of the system.

9 Limitations and future recommendations

The first the limitation to be considered is that the study proposes and tests a new framework in ERP environment. The data for this scholarly work was collected and analyzed from a subsect of universities of Pakistan. Regardless of the significant relationships among constructs, these results may not be generalized to other sectors. The constructs used in this study and their relationships can be used for further investigation in different industries.

Second, the framework of the current study is based on the constructs from D & M IS success model and TAM. Therefore, other factors related to users such as user resistance, user characteristics influencing user performance may be explored by extended this framework. Third, the target population were the users regardless of their designations. Hence, researchers may target users in different layers such as academic and non-academic staff.

10 Conclusions

Upon the integration of the D&M IS success model and TAM, the study proposes and tested a framework to test system's effect on users. The framework clarifies how ERP quality factors (system quality, information quality, service quality) influence perceived usefulness, perceived ease of use and user satisfaction from user's perspective. The study goes further to investigate the effect of perceived usefulness, perceive ease of use and user satisfaction on user performance. The results showed that significance influence exists from exogenous constructs on user performance in ERP system environment. The findings also established the importance of perceived usefulness and perceived ease of use representing TAM's portion in ERP environment in higher education's institutions of Pakistan.

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Appendix B Questionnaire items

System quality (Hsu *et al.*, 2015); (Gable *et al.*, 2008); (Nelson *et al.*, 2005)
SQ1 The CMS system is easy to use
SQ2 The CMS system is easy to learn
SQ3 The CMS system always processes data accurately
SQ4 The CMS system requires only a minimum number of fields and screens to complete a task
SQ5 The CMS system meets my requirements.
SQ6 The CMS system includes necessary features and functions for my job.
SQ7 The CMS system user interface can be easily adapted to my personal approach.
SQ8 All the data that I use within the CMS system are fully integrated and consistent
SQ9 The CMS system can be easily modified or improved according to my needs.
Information Quality (Hsu *et al.*, 2015); (Gable *et al.*, 2008); (Nelson *et al.*, 2005)
IQ1 The CMS system provides output that is exactly what I want
IQ2 Information needed from the CMS system is always available
IQ3 Information from the CMS system is in a form that is readily usable
IQ4 Information from the CMS system is easy to understand
IQ5 Information from the CMS system appears readable, clear, and well formatted
IQ6 Information from CMS system is concise
Service quality (Hsu *et al.*, 2015); (Pitt *et al.*, 1995); (Parasuraman *et al.*, 1988)
Reliability
SRQ1 The IT department provides its services at the time it promises to do
SRQ2 When users have a problem, the IT staff shows a sincere interest in solving it
SRQ3 The IT department is reliable
SRQ4 The IT department insists on error-free records
Responsiveness
SRQ5 The IT staff informs users exactly when services will be performed
SRQ6 The IT staff gives prompt service to users.
SRQ7 The staff of the IT department is never too busy to respond to user's requests.
Assurance
SRQ8 The behaviour of the staff in IT department boosts the confidence of users.
SRQ9 I feel safe in my dealings with the IT staff
SRQ10 IT staff is consistently courteous with users.
SRQ11 The IT staff have the knowledge to do their job well
Empathy
SRQ12 The IT department has operating hours convenient to all users.
SRQ13 The IT department gives users individual attention
SRQ14 The IT department has the users' best interests at heart
SRQ15 The staff of the IT department understand the specific needs of the users
Perceived usefulness (Abugabah *et al.*, 2015)
PU1 Using the CMS system improves my performance in my job
PU2 Using the CMS system in my job increases my productivity
PU3 Using the CMS system enhances my effectiveness in my job
PU4 I find the system to be useful in my job
Perceived ease of use (Abugabah *et al.*, 2015)
PEOU1 I find the CMS system easy to use
PEOU2 I find it easy to get the CMS system to do what I want it to do
PEOU3 My interaction with the CMS system is clear and understandable.
PEOU4 Interacting with the system does not require a lot of my mental efforts
User satisfaction (Lin, 2010)
US1 The information I get from CMS system is very satisfying
US2 My interaction with CMS system is very satisfying
US3 Overall, I am very satisfied with CMS system
User performance (Abugabah *et al.*, 2015)
UP1 The quality of the CMS system enables me to accomplish my work
UP2 Our CMS system has a positive impact on my productivity
UP3 Using CMS system in my job enables me to accomplish multiple tasks more quickly
UP4 Overall, our CMS system improves my efficiency in my job
UP5 Our CMS system helps me solve my job problems
UP6 Our CMS system reduces performance errors in my job
UP7 Our CMS system enhances my effectiveness in my job

UP8	Our CMS system helps me create new ideas in my job
UP9	Our CMS system enhances my creativity
UP10	Overall, our ERP system helps me achieve my job goals

Appendix C Cross loadings

	SQ	IQ	REL	RESP	ASSU	EMP	PU	PEOU	US	UP
SQ2	0.686	0.489	0.452	0.505	0.486	0.442	0.480	0.476	0.490	0.401
SQ3	0.777	0.471	0.482	0.548	0.527	0.468	0.406	0.531	0.541	0.451
SQ4	0.791	0.527	0.538	0.605	0.584	0.492	0.402	0.530	0.547	0.468
SQ5	0.781	0.558	0.464	0.527	0.529	0.511	0.582	0.533	0.492	0.471
SQ6	0.650	0.532	0.424	0.511	0.472	0.489	0.458	0.498	0.534	0.531
SQ8	0.727	0.586	0.425	0.516	0.447	0.492	0.465	0.492	0.500	0.574
SQ9	0.785	0.473	0.463	0.588	0.510	0.533	0.578	0.546	0.570	0.589
IQ1	0.412	0.776	0.454	0.578	0.487	0.516	0.581	0.590	0.409	0.445
IQ2	0.421	0.819	0.455	0.527	0.443	0.371	0.459	0.526	0.544	0.595
IQ3	0.561	0.849	0.371	0.477	0.311	0.382	0.491	0.544	0.540	0.565
IQ4	0.401	0.874	0.451	0.481	0.419	0.436	0.470	0.504	0.544	0.590
IQ5	0.582	0.851	0.417	0.471	0.407	0.413	0.456	0.509	0.544	0.509
IQ6	0.553	0.794	0.370	0.461	0.372	0.442	0.528	0.493	0.489	0.570
SRQ1	0.422	0.296	0.662	0.375	0.468	0.392	0.344	0.403	0.429	0.456
SRQ2	0.417	0.365	0.750	0.351	0.363	0.305	0.286	0.299	0.329	0.365
SRQ3	0.553	0.472	0.837	0.553	0.493	0.413	0.399	0.421	0.446	0.524
SRQ5	0.522	0.418	0.534	0.813	0.485	0.479	0.426	0.478	0.490	0.557
SRQ6	0.471	0.569	0.501	0.864	0.539	0.518	0.315	0.496	0.408	0.478
SRQ7	0.427	0.526	0.411	0.821	0.517	0.571	0.571	0.499	0.512	0.496
SRQ9	0.372	0.204	0.512	0.362	0.693	0.352	0.141	0.228	0.314	0.346
SRQ10	0.408	0.407	0.449	0.578	0.802	0.520	0.492	0.492	0.519	0.581
SRQ11	0.569	0.502	0.417	0.461	0.802	0.521	0.390	0.441	0.486	0.552
SRQ12	0.369	0.254	0.356	0.375	0.500	0.740	0.287	0.245	0.269	0.352
SRQ13	0.492	0.498	0.371	0.496	0.424	0.779	0.514	0.472	0.486	0.519
SRQ14	0.369	0.463	0.443	0.595	0.527	0.847	0.317	0.542	0.528	0.321
PU1	0.590	0.476	0.350	0.498	0.358	0.504	0.813	0.541	0.530	0.410
PU2	0.580	0.472	0.384	0.537	0.368	0.491	0.841	0.553	0.532	0.511
PU3	0.561	0.525	0.386	0.575	0.398	0.553	0.880	0.437	0.593	0.474
PU4	0.520	0.556	0.429	0.564	0.426	0.512	0.836	0.560	0.389	0.498
PEOU1	0.493	0.429	0.350	0.454	0.380	0.396	0.421	0.686	0.463	0.455
PEOU2	0.524	0.468	0.396	0.395	0.442	0.300	0.329	0.621	0.421	0.494
PEOU3	0.420	0.556	0.429	0.564	0.426	0.512	0.436	0.860	0.489	0.598
PEOU4	0.516	0.471	0.338	0.468	0.319	0.401	0.685	0.820	0.543	0.548
US1	0.613	0.530	0.442	0.539	0.508	0.456	0.496	0.397	0.843	0.524
US2	0.524	0.468	0.396	0.395	0.442	0.300	0.329	0.321	0.721	0.494
US3	0.520	0.556	0.429	0.564	0.426	0.512	0.533	0.586	0.789	0.440
UP1	0.562	0.513	0.574	0.500	0.546	0.532	0.559	0.543	0.539	0.723
UP2	0.536	0.510	0.332	0.443	0.400	0.375	0.493	0.404	0.377	0.612
UP3	0.594	0.524	0.419	0.475	0.456	0.380	0.540	0.482	0.481	0.704
UP4	0.448	0.436	0.395	0.397	0.459	0.383	0.377	0.436	0.451	0.580
UP5	0.520	0.556	0.429	0.564	0.426	0.512	0.436	0.350	0.489	0.798
UP6	0.567	0.478	0.387	0.547	0.457	0.468	0.587	0.501	0.456	0.676
UP7	0.313	0.530	0.442	0.539	0.508	0.456	0.496	0.397	0.443	0.724
UP8	0.493	0.429	0.350	0.454	0.380	0.396	0.421	0.486	0.463	0.655