Telematics and Informatics 35 (2018) 1421–1437

Contents lists available at ScienceDirect

Telematics and Informatics

journal homepage: www.elsevier.com/locate/tele

The role of transformational leadership as a mediating variable in DeLone and McLean information system success model: The context of online learning usage in Yemen

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ARTICLE INFO

Keywords:
Online learning
IS success model
DeLone and McLean
Transformational leadership
Yemen

ABSTRACT

Governments and higher education institutions around the world are placing online learning in their respective visions and policies as it has already transformed the way in which individuals learn, socialise and do business. Leadership is therefore increasingly playing a major role in the implementation and success of online learning goals. Although researchers have investigated adoption and usage of online learning in different settings, the mediation role of transformational leadership is yet to be examined using the Delone and Mclean IS success model. Data collected from 448 students in nine Yemeni public universities and the subsequent analysis employing structural equation modelling (SEM) via SmartPLS 3.0, revealed five main results: first, overall quality (system, information, and service quality) has a positive impact on transformational leadership; second, transformational leadership has a positive impact on actual usage; third, overall quality has an indirect positive effect on actual usage via transformational leadership; fourth, actual usage significantly affects user satisfaction and performance impact; and fifth, user satisfaction has a positive impact on student performance. The proposed model explains 61% of the variance in performance impact, and theoretical and practical implications are provided as well.

1. Introduction

Online learning has been used interchangeably with a number of similar terms like 'elearning', 'distance learning' and 'blended learning'. According to Clark & Mayer (2016), it is defined as delivering instructions via the internet, using digital devices like smartphones, laptops, tablets, and desktop computers. Governments worldwide are utilising it as part of their initiatives to promote technology in the educational process (Tenório et al., 2016). Although, Yemen scored poorly (11.2 out of 100) in the information and communication technology (ICT) use indicator by Global Innovation Index (2017), mobile gadgets are an exception with Yemen having a subscription rate of 67.98% per 100 people (World Development Indicators, 2017). Many governments have successfully expanded educational opportunities by leveraging on the technology people already possess, rather than providing new devices (UNESCO, 2013). The Yemeni government could take the opportunity to promote online learning through mobile gadgets, because several studies have asserted that students in Yemen's higher education institutions are familiar with mobile gadgets usage and they exhibit a positive attitude towards the use of online learning (Tuparov et al., 2015). Further, other studies indicated the benefits of

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https://doi.org/10.1016/j.tele.2018.03.012
Received 26 November 2017; Received in revised form 10 February 2018; Accepted 15 March 2018
Available online 17 March 2018

online learning such as time and effort saving, enhanced learning effectiveness, availability of up-to-date and accurate knowledge with high responsiveness, multimedia content, and interactive communication (Almaiah et al., 2016; Domingo & Garganté, 2016; and Isaac et al., 2017b,c). However, Yemen is facing several challenges in the education sector such as imperfect infrastructure and lack of individual awareness (Aldowah et al., 2015). Besides, Yemen is currently in the midst of a civil and regional war that is seriously affecting universities and public thoroughfares, technology infrastructure such as that supplied by mobile devices offers an optimal solution for learners who are in post-crisis areas because it is quicker and easier to restore. This notion is supported by UNESCO (2013) that refers to the ability of online learning in conflict areas as a cost effective with minimum infrastructure tool that could help in minimising any disruption of the educational process.

Many theories and models have been developed and proposed in the information systems (IS) context in order to predict and explain user behaviour with technology. Besides the DeLone and McLean Model of Information Systems Success (DMISM) (Delone & Mclean, 1992; and Delone & Mclean, 2003), other well-known theories and models exist including the Technology Acceptance Model (TAM) (Davis, 1989), the Diffusion of Innovation Theory (DOI) (Rogers, 1995), the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), the Theory of Planned Behavior (TPB), (Ajzen, 1985), the Model of PC Utilization (MPCU) (Chang and Cheung, 2001), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). There are also empirical studies which have comprehensively examined the adoption and use of new technologies (Al-Busaidi, 2013; Islam, 2015; and Šumak et al., 2011). These theories and models have largely neglected the evaluation of information technology (IT) usage (Islam, 2013), with the exception of DMISM which evaluates IT usage by examining the effect of overall quality (system, information, and service quality) on user satisfaction and actual usage which in turn influence performance impact and which has become widely used to measure the success of IS (Montesdioca & Maçada, 2015).

There is also a contradiction in the results from some studies. For instance, while some researchers found that overall quality significantly affects actual usage (Jung et al., 2015; Ramirez-Correa et al., 2017; and Tam & Oliveira, 2016), others reported the insignificance of such a relationship (Aparicio et al., 2017; Chiu et al., 2016; and Dokhan & Akkoyunlu, 2016). This shows that there may be other intervening variables depending on the context and application of the research. Leadership is seen as a crucial facilitator in the use of an information system (Elkhani et al., 2014; and Rezvani et al., 2017). However, according to the Critical Human Capital Issues report (2014), one of the main critical issues for high-performance organisations compared to low-performance ones is leadership development. Recent IS studies are therefore putting more emphasis on transformational leadership (TL) as an important factor (Bai et al., 2016; Cho et al., 2011; Jung et al., 2008; Ömer & Göknur, 2014; and Rezvani et al., 2017). This study proposes an extended Delone & Mclean information system success model that includes transformational leadership as a mediating variable between overall quality and actual usage. Proposing such variable is because Yemen is a country where people accept hierarchical order and power where centralisation is popular (Hofstede and Minkov, 2010a). To the best of our knowledge, this study will be the first to use TL as a mediating variable in the relationship between overall quality and actual usage in the context of online learning in Yemen.

It is important to mention that the majority of studies utilising the Delone & Mclean IS model were conducted in western countries and none have been tried in the context of online learning in Yemen where the culture is vastly different. The findings could help provide important insights for universities and policy makers to counter the challenges they face in Yemen's higher education sector.

2. Literature review

2.1. Overall quality

Due to growing challenges and sophisticated developments in the field of information systems, scholars and practitioners are encouraged to improve both the quality and functionality of new systems in order to tap into future growth prospects (Wang & Lai, 2014). Overall quality has been studied as second order construct that containing system quality, information quality and service quality (Ho et al.,2010; and Isaac, Abdullah, Ramayah, & Mutahar, 2017a). System quality is defined as the degree to which the system users believe that a system is easy to use, user-friendly, easy to learn, easy to connect to, and enjoyable to use (Petter & McLean, 2009), while information quality is defined as the degree to which system users think that online learning information is up-to-date, accurate, relevant, comprehensive, and organised (Halonen et al., 2009). Service quality is referred to through these attributes: tangible, reliability, responsiveness, assurance, functionality, interactivity, and empathy (Delone & McLean, 2003; Lin et al., 2011; and Pituch & Lee, 2006). This study proposes that the higher the overall quality of new technology the more likely senior management and leaders are to encourage and motivate individuals to use it. Consequently, the following hypothesis is proposed:

H1. Overall quality has a positive effect on transformational leadership.

2.2. Transformational leadership

The role of transformational leadership (TL) has become increasingly important in studying information system success and technology adaption (Alos-Simo et al., 2017). In general TL is about motivating followers to work for higher goals to fulfil self-actualizing needs (Riggio & Bass, 1997). It is also defined based on four elements, namely charisma, individual consideration, intellectual stimulation, and inspirational motivation (Elkhani et al., 2014; Schepers et al., 2005). To achieve success in the IS field and more specifically in online learning, university lecurers can demonstrate a high level of confidence in its use by providing support, facilities and coaching. Management can provide further encouragement by widely reporting positive students experiences with online learning

(Cho et al., 2011). There is a mounting consensus on the need to study the effect of leadership on the adoption and use of new technologies (Ali et al., 2017; Dubelaar et al., 2005), and this can be seen as a reflection of previous studies that reported a significant effect of leadership on innovation processes (Boerner et al., 2007; Gumusluoglu & Ilsev, 2009; Jung et al., 2008). TL is also explorative in nature and this makes it relevant to the adoption of new technology (Flatten et al., 2015; Sun & Anderson, 2012). Ghazali et al. (2015) reported that TL significantly influences system success which obviously resulted from system usage. As Hofstede & Minkov (2010b) illustrate that Yemeni culture has a low tendency towards risk taking, leadership could play a major role in encouraging and motivating individuals to use their mobile gadgets as learning too, which is equivalent to the lecturer's role to inspire, encourage and motivate students to utilize online learning. Nevertheless, they also mentioned that Yemen has a collectivism rather than individualism culture which means that individuals are not self-driven and need an external motivator within their social group. This notion affirms the significant effect of leadership to influence and encourage students to utilize new technology such as online learning. Bouwmans et al. (2017) found that Transformational leadership was directly and indirectly positively associated with team learning, which is seen as an establishment of transformational leadership role in learning field. This study will therefore examine the mediation effect of transformational leadership on the relationship between overall quality and actual usage on the basis of the confirmed direct effect of overall quality on actual usage (Culibrk et al., 2016; and Isaac et al., 2017b) and the significant effect of transformational leadership on actual usage (Ghazali et al., 2015). Consequently, the following hypotheses are proposed:

H2. Transformational leadership has a positive effect on actual usage.

H6. Transformational leadership mediates the relationship between overall quality and actual usage.

2.3. Actual usage

According to DeLone & McLean (2016) actual usage is the degree to which an individual uses the capabilities of an information system in terms of frequency, nature and duration of use. In online learning, actual usage also reflects the frequency and duration of use (Kim et al., 2007a,b). DeLone & McLean (2016) also indicated that among the most important directions in technology usage is to the need to assess the impact of system usage on IS success factors like performance. Several studies have examined the influence of actual usage on performance and satisfaction (Hou, 2012; Son et al., 2012). Despite a mixed bag of results, it was determined that there is a significant relationship between actual usage and each of satisfaction and performance (D'Ambra et al., 2013; Isaac et al., 2017b; Makokha & Ochieng, 2014; Ramirez-Correa et al., 2017). However, there are other studies which reported the insignificance of this relationship (Cho et al., 2015; Wu & Wang, 2006). While other studies examined the effect of satisfaction on actual usage (Jafari et al., 2011), this study examines the effect of actual usage on satisfaction as recommended by Isaac et al. (2017a,b) Consequently, the following hypotheses are proposed:

H3. Actual usage has a positive effect on user satisfaction.

H4. Actual usage has a positive effect on performance impact.

2.4. User satisfaction

As user satisfaction is considered one of the main indicators when assessing the success of new system adoption, it has been widely used as a measure in the field of IS (DeLone & McLean, 2016; Montesdioca & Maçada, 2015). According to Xinli (2015), user satisfaction refers to the extent to which a user perceives a system to be useful and wants to use it again. While Lin and Wang (2012) defined it as system user's satisfaction with regard to system speed, number of functions, quality and format. It has also been defined as the degree to which students using online learning are satisfied with their decision to use it and how well it meets their expectations (Roca et al., 2006; Wang, 2008; Wang & Liao, 2008). A number of studies have shown that user satisfaction impacts performance in numerous contexts and technology applications. For instance, Isaac et al. (2017a–e) reported that user satisfaction significantly influenced performance impact, and Culibrk et al. (2016) found the same significant relationship between user satisfaction and net benefits. However, Daud et al. (2011) reported that there was no significant relationship between user satisfaction and performance impact. Consequently, the following hypothesis is proposed:

H5. User satisfaction has a positive effect on performance impact.

2.5. Performance impact

IS scholars have used the intention to use or actual usage as the dependent variable when examining factors affecting the adoption of certain technology system (Cheng et al., 2015; Cheung & Vogel, 2013; Iqbal & Qureshi, 2012). However, with rapidly changing technology and the introduction of many new systems, the focus is currently directed towards the outcome of system usage in terms of performance enhancement to evaluate and measure system success (Isaac et al., 2017a–e; Chen, 2013; Montesdioca & Maçada, 2015). Performance impact is defined as the extent to which system usage increases the quality of work by helping to complete the task quickly, allow control over work, improve job performance, eliminate errors, and boost effectiveness on the job (Isaac et al., 2016a,b; Norzaidi et al., 2007). In this study, performance impact is defined as the degree that online learning impacts student performance in terms of resource savings, productivity, competence, and knowledge acquisition (Isaac et al., 2017a–e).

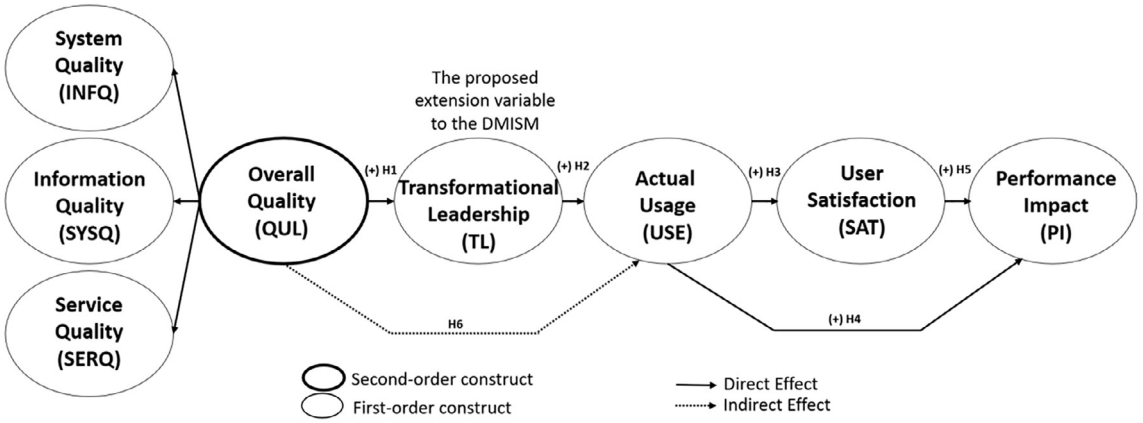


Fig. 1. The Proposed Integration Model.

3. Research method

3.1. Overview of the proposed research model

For this study, the hypothesized variables and their relationships in the model have been derived from the available literature of the models and theories that have been prescribed in the literature mentioned above. The proposed extended model can be seen in Fig. 1 below. While examining the proposed model, it can be seen that overall quality (containing system quality, information quality and service quality) affects user satisfaction and actual usage constructs, which both predict performance impact. These relationships are derived from Delone & McLean (2003), whereas TL is taken from Ghazali et al. (2015) and Rezvani et al. (2017). The proposed extended model examines the indirect relationship between overall quality and actual usage via TL as antecedent variables to user satisfaction which in turn explains performance impact together with actual usage as an output variable among students who used or are still using online learning in nine public universities in Yemen. The proposed model has six hypotheses to test.

3.2. Development of Instrument

A 30-item questionnaire was developed for this study, and in line with existing literature in the IS field, a multi-item Likert scale was applied (Lee et al., 2009). The variables were measured using the 7-point Likert Scale, with 7 being 'Strongly Agree' and 1 being 'Strongly Disagree', except for actual usage which was measured using a 5-rank scale. Because respondents were Arabic-speakers, it was vital that the questionnaire be precisely translated from English to Arabic. Therefore a back translation was performed, a procedure extensively applied to test the precision of the translation in a cross-cultural survey (Brislin, 1970). Validated instruments were adapted from related previous studies to measure the variables of this study as shown in Appendix A. With regard to item count for every construct, this study followed the directions of Hayduk and Littvay (2012) who suggested using the few best items, and that many items are rarely warranted because additional redundant items provide less research benefit.

3.3. Data collection

Data collection was conducted using a self-administered paper questionnaire which was delivered 'in-person' from October 2016 till April 2017 to students who had used or were using online learning in the main libraries of nine public universities in Yemen. The students were approached while in library facilities because these contain computer labs and students were from different fields, backgrounds and faculties. After verifying whether the students used or are using online learning, they were given the questionnaire to be filled and left at the same place to be collected in the same day. A total of 800 questionnaires were distributed, with 464 sets returned of which 448 responses were useful for the analysis. The final sample size was considered as adequate (Krejcie & Morgan, 1970; Tabachnick & Fidell, 2012). The 58% response rate is considered very good (Cable & Derue, 2002) and above average (Baruch & Holtom, 2008) by comparison with other studies found in the relevant literature. A total of 16 questionnaires were deleted of which 13 cases were removed due to missing data for more than 15% of the questions and 3 cases involving straight lining. The demographic profile of the respondents is shown in Table 1.

4. Data analysis and results

This study employed the Structural Equation Modeling-Variance Based (SEM-VB) through Partial Least Squares (PLS) method to analyze the research model using SmartPLS 3.0 software (Ringle et al., 2015). After the descriptive analysis, this study followed the two-stage analytical technique recommended by Anderson & Gerbing (1988) and Hair et al. (2017), starting with the measurement model assessment (validity and reliability), followed by the structural model assessment (testing the hypothesized relationships).

Table 1
Summary of demographic profile of respondents.

Demographic Item	Categories	Frequency	Percentage
Gender	1. Male	240	53.5
	2. Female	208	46.4
Marital Status	1. Single	379	84.6
	2. Married	53	11.8
	3. Divorced	5	1.1
	4. Widowed	1	0.2
	5. Others	10	2.2
Age	1. Less than 20 years	85	19.0
	2. 20–29 years	343	76.6
	3. 30–39 years	16	3.6
	4. 40–49 years	3	0.7
	5. 50 years and above	1	0.2
Education Background	1. High School	218	48.7
	2. Diploma	51	11.4
	3. Bachelor Degree	156	34.8
	4. Master Degree	11	2.5
	5. Ph.D./DBA Degree	3	0.7
	6. Others	9	2.0
Faculty	1. Applied Science	356	79.4
	2. Social, Humanities & Art	92	20.5

Schumacker & Lomax (2004) and Hair et al. (2010) indicate that the two-step assessment procedure, which includes both measurement and structural models, has an advantage over the one step assessment procedure. According to Hair et al. (2017), the measurement model specifies how each construct is measured, while the structural model specifies how the variables are related to each other in the structural model. The main reason for choosing PLS as a statistical method for this study is that PLS offers simultaneous analysis of both measurement and structural model leading to more accurate estimates (Barclay et al., 1995).

4.1. Descriptive analysis

Table 3 presents the mean and standard deviation of each variable in the current study. The respondents were asked to indicate their opinion in relation to their online learning usage based on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Information quality recorded the highest mean score of 5.088 out of 7.0, with a standard deviation of 1.447, indicating that the respondents were aware of the quality of internet information. System quality recorded a mean score of 4.773 out of 7.0, with a standard deviation of 1.601, indicating that the respondents consider online learning easy to use, understandable and flexible. Service quality recorded a mean score of 4.824 out of 7.0, with a standard deviation of 1.504, indicating that the respondents agreed that online learning could be used at anytime and anywhere, offers multimedia (audio, video, and text) types of course content, and enables interactive communication. User satisfaction recorded a mean score of 4.679 out of 7.0 with a standard deviation of 1.559, indicating that the level of satisfaction of the respondents with online learning usage is high. Further, performance impact recorded a mean score of 4.747 out of 7.0 points with a standard deviation of 1.382, indicating that the respondents agreed that using online learning helped them to accomplish tasks more quickly and easily, improves academic effectiveness and generally acquire new knowledge, new skills and the ability to come up with innovative ideas. Finally, out of 448 respondents, 288 agreed that online learning helped them to accomplish their tasks more quickly, 291 agreed that online learning made it easier for them to complete their tasks, 294 agreed that online learning enhanced their academic effectiveness, and 312 agreed that online learning help them to acquire new skills.

4.2. Measurement model assessment

Assessment of the measurement model was done through construct reliability as well as validity (including convergent and discriminant validity). For construct reliability, this study tested the individual Cronbach's alpha coefficients to measure the reliability of each of the core variables in the measurement model. The results indicate that all the individual Cronbach's alpha coefficients ranging from 0.818 to 0.959 were higher than the suggested value of 0.7 (Kannana & Tan, 2005; Nunnally & Bernstein, 1994). Additionally, for testing construct reliability all the composite reliability (CR) values ranging from 0.905 to 0.965 were higher than 0.7 (Werts et al., 1974; Kline, 2010; Gefen et al., 2000), which adequately indicates that construct reliability is fulfilled as shown in Table 2. Therefore, the achieved Cronbach's Alpha and CR for all constructs were considered to be sufficiently error-free.

Factor loading was used to test *indicator reliability*. High loadings on a construct indicate that the associated indicators seem to have much in common, which is captured by the construct (Hair et al., 2017). Factor loadings greater than 0.50 were considered to be very significant (Hair et al., 2010). The loadings for all items exceeded the recommended value of 0.5 as shown in Table 2, except for item INFQ5 which was eliminated from the scale due to low loadings. The loading for the remaining items in the model has fulfilled all the requirements.

Table 2
Mean, standard deviation, loading, cronbach's Alpha, CR and AVE.

First-order constructs	Second-order construct	Item	Indicators	Loading (> 0.5)	M	SD	α (> 0.7)	CR (> 0.7)	AVE (> 0.5)
System quality (SYSQ)		SYSQ1	- Easy to use	0.872	4.773	1.601	0.848	0.908	0.767
		SYSQ2	- Flexible	0.885					
		SYSQ3	- Understandable	0.871					
Information quality (INFQ)		INFQ1	- Up-to-date	0.857	5.088	1.447	0.87	0.911	0.719
		INFQ2	- Accurate	0.823					
		INFQ3	- Relevant	0.85					
		INFQ4	- Comprehensive	0.864					
		INFQ5	- Organized	Deleted					
Service Quality (SERQ)		SERQ1	- Responsiveness	0.894	4.824	1.504	0.875	0.923	0.8
		SERQ2	- Functionality	0.915					
		SERQ3	- Interactivity	0.874					
	Overall Quality (QUL)	SYSQ	- System quality	0.865	4.93	1.327	0.926	0.906	0.763
		INFQ	- Information quality	0.92					
		SERQ	- Service quality	0.834					
Transformational Leadership (TL)		TL1	- Intellectual stimulation	0.839	4.319	1.474	0.865	0.908	0.713
		TL2	- Inspirational motivation	0.879					
		TL3	- Individualized consideration	0.847					
		TL4	- Idealized influence	0.811					
Actual usage (USE)		USE1	- Frequency of usage	0.923	4.286	1.223	0.818	0.916	0.846
		USE2	- Duration of use	0.917					
User satisfaction (SAT)		SAT1	- Satisfied with the decision	0.925	4.679	1.559	0.915	0.946	0.845
		SAT2	- Meet the expectations	0.926					
		SAT3	- Overall satisfaction	0.921					
Performance impact (PI)		PI1	- Time saving	0.86	4.747	1.382	0.959	0.965	0.732
		PI2	- Effort saving	0.871					
		PI3	- Cost saving	0.817					
		PI4	- Improves performance	0.87					
		PI5	- Enhances effectiveness	0.871					
		PI6	- Eliminate errors	0.852					
		PI7	- Realize future target	0.852					
		PI8	- Acquire new knowledge	0.862					
		PI9	- Acquire new skills	0.862					
		PI10	- Come up with innovative ideas	0.838					

Note: M = Mean; SD = Standard Deviation, α = Cronbach's alpha; CR = Composite Reliability, AVE = Average Variance Extracted.
The measurement used is seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree), only actual usage used 7 ranking scale.
All the factor loadings of the individual items are statistically significant ($p < 0.01$) except for the item INFQ5 which eliminated from the scale due to low loadings.
Key: SYSQ: system quality, INFQ: information quality, SERQ: service quality, QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction, PI: performance impact.

Table 3
Results of discriminant validity by Fornell-Larcker criterion.

	Factors	1	2	3	4	5
		PI	QUL	SAT	TL	USE
1	PI	**0.856**				
2	QUL	0.661	**0.873**			
3	SAT	0.728	0.667	**0.924**		
4	TL	0.476	0.448	0.519	**0.844**	
5	USE	0.693	0.599	0.654	0.410	**0.920**

Note: Diagonals represent the square root of the average variance extracted while the other entries represent the correlations.
Key: QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction, PI: performance impact.

For testing *convergent validity (*the extent to which a measure correlates positively with alternative measures of the same construct), this study used the average variance extracted (AVE), and it indicated that all AVE values were higher than the suggested value of 0.50 (Hair et al., 2010) ranging from 0.713 to 0.846. The convergent validity for all constructs has been successfully fulfilled and adequate convergent validity exhibited as Table 2 shows.

The discriminant validity (the degree to which items differentiate among constructs or measure distinct concepts) of the measurement model was checked using three criteria, namely cross-loadings, Fornell-Larcker and the heterotrait-monotrait ratio (HTMT).

Table 4
Results of discriminant validity by HTMT.

	Factors	1	2	3	4	5
		PI	QUL	SAT	TL	USE
1	PI					
2	QUL	0.703				
3	SAT	0.776	0.725			
4	TL	0.522	0.503	0.583		
5	USE	0.782	0.689	0.755	0.487	**0**

Key: QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction, PI: performance impact.

According to (Hair et al., 2017), the cross-loadings are typically the first approach to assess discriminant validity of the indicators. As shown in Appendix B the cross loading criterion fulfils the requirements because the indicators outer loadings on a construct were higher than all its cross-loadings with other constructs (bold values).

The results of discriminant validity by using the Fornell-Larcker criterion is shown in Table 3, where the square root of the AVEs on the diagonals, as represented by the bolded values, are higher than the correlations between constructs (corresponding row and column values). This indicates that the constructs are strongly related to their respective indicators compared to other constructs of the model (Fornell & Larcker, 1981; Chin, 1998a,b), thus suggesting a good discriminant validity (Hair et al., 2017). In addition, the correlation between exogenous constructs is less than 0.85 (Awang, 2014). Hence, the discriminant validity of all constructs is fulfilled.

There has been some criticism of the Fornell-Larcker criterion, Henseler et al. (2015) mentioned that it does not accurately reveal the lack of discriminant validity in common research situations. They have proposed an alternative technique which is the hetero-trait-monotrait ratio (HTMT) of correlations based on the multitrait-multimethod matrix. This study assesses discriminant validity through HTMT. While the discriminant validity has a problem when the HTMT value is greater than $HTMT_{0.90}$ value of 0.90 (Gold et al., 2001), or the $HTMT_{0.85}$ value of 0.85 (Kline, 2010), all values as Table 4 shows were lower than the recommended value of 0.85 indicating that discriminant validity has been ascertained.

4.3. Structural model assessment

Hair et al. (2017) suggested assessing the structural model by looking at the beta (β), R^2 and the corresponding t-values via a bootstrapping procedure with a resample of 5,000. Moreover, they recommend reporting the effect sizes (f^2) as well as the predictive relevance (Q^2). As Sullivan & Feinn (2012) argue, the p-value determines whether the effect exists but it does not reveal the size of the effect.

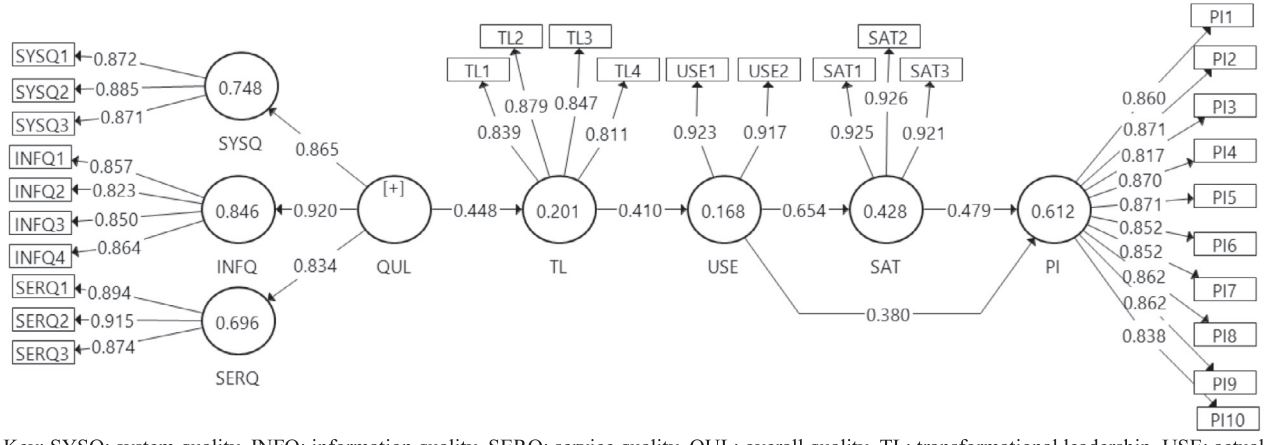
4.3.1. Hypotheses tests

The structural model assessment as shown in Fig. 2 and Table 5 provides the indication of the hypothesis tests. Overall quality significantly predicts transformational leadership. Hence, H1 is accepted with ($\beta = 0.448$, $t = 10.155$, $p < 0.001$). Likewise, transformational leadership significantly predicts actual usage of online learning. Hence, H2 is supported ($\beta = 0.410$, $t = 9.972$, $p < 0.001$). Actual usage of online learning significantly predicts user satisfaction. Hence, H3 is supported ($\beta = 0.654$, $t = 24.607$, $p < 0.001$). These are similar to actual usage of online learning and user satisfaction which were found to significantly influence performance impact. Hence, H4 and H5 are accepted with ($\beta = 0.380$, $t = 10.107$, $p < 0.001$) and ($\beta = 0.479$, $t = 13.719$, $p < 0.001$) respectively.

Regarding the mediation hypotheses (indirect hypotheses), Baron and Kenny (1986) mentioned that a variable functions as a mediator when it meets the following conditions: (1) the predictor variable must significantly predict the outcome variable when the mediator is excluded; (2) the predictor variable must significantly predict the mediator; (3) the mediator must significantly predict the outcome variable; and (4) the predictor variable must predict the outcome variable less strongly when the mediator enters the model. However, Hayes (2009) identified problems with the Baron and Kenny approach in his article "Beyond Baron and Kenny: Statistical mediation analysis in the new millennium" and proposed full solutions in his book (Hayes, 2013) to test the mediation effect by determining the indirect effect ~~by~~ using the bootstrapping method. Hair et al. (2017) recommend that when testing mediating effects, researchers should follow Preacher & Hayes (2004) and Preacher & Hayes (2008).

The test of the indirect effect (mediation effect) of overall quality on actual usage through transformational leadership in this study is based on the Preacher & Hayes (2004) and Preacher & Hayes (2008) method of bootstrapping the indirect effect. Table 5 shows the result of the bootstrapping analysis, indicating that the indirect effect $\beta = 0.184$ was significant with a t-value of 5.653. Preacher and Hayes (2008) indicate that when the 0.184, 95% Boot CI: [LL = 0.116, UL = 0.244] does not straddle a 0 in between, this indicates there is mediation. Thus, this study can conclude that the mediation effect of transformational leadership is statistically significant between overall quality and actual usage, indicating that H6 is also supported.

Overall quality explains 20% of the variance in transformational leadership. In addition, transformational leadership explains 17% of the variance in actual usage. Actual usage explains 43% of the variance in user satisfaction, while actual usage and user



Key: SYSQ: system quality, INFQ: information quality, SERQ: service quality, QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction, PI: performance impact.

Fig. 2. PLS algorithm results. Key: SYSQ: system quality, INFQ: information quality, SERQ: service quality, QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction, PI: performance impact.

Table 5
Structural path analysis result.

Hypothesis	Relationship	Std Beta	Std Error	t-value	p-value	LL	UL	Decision	R^2	f^2	Q^2	VIF
H1	QUL → TL	0.448	0.044	10.155	0.000	0.352	0.527	Supported	0.20	0.252	0.132	1.000
H2	TL → USE	0.410	0.041	9.972	0.000	0.323	0.485	Supported	0.17	0.202	0.131	1.000
H3	USE → SAT	0.654	0.027	24.607	0.000	0.597	0.701	Supported	0.43	0.747	0.334	1.747
H4	USE → PI	0.380	0.038	10.107	0.000	0.311	0.456	Supported	0.61	0.213	0.411	
H5	SAT → PI	0.479	0.035	13.719	0.000	0.407	0.543	Supported		0.339		1.747
H6	QUL → TL→PI	0.184	0.033	5.635	0.000	0.116	0.244	Supported				

Key: QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction, PI: performance impact.

satisfaction explain 61% of the variance in performance impact. The R^2 values achieved an acceptable level of explanatory power as recommended by Cohen (1988) and Chin (1998a,b) indicating a substantial model.

This study also assessed effect sizes (f^2). Effect size f^2 determines whether an exogenous latent construct has a substantial, moderate or weak impact on an endogenous latent construct (Gefen & Rigdon, 2011). Hair et al., (2017) recommend to test the change in the R^2 value. Cohen (1988) suggested as a guideline measure, a magnitude of f^2 at 0.35 (large effects), 0.15 (medium effects) and 0.02 (small effects). The result of f^2 as Table 5 shows, one relationship with large effect sizes, and the remaining relationships with medium effect sizes.

Using the blindfolding procedure, this study examined the power of the proposed research model regarding predictive relevance. As recommended by Hair et al., (2017) the blindfolding procedure should only be used on endogenous constructs with a reflective measurement. If the value of Q^2 is greater than 0, then the predictive relevance of the proposed model exists for a certain endogenous construct (Fornell and Cha, 1994; Hair et al., 2017). As Table 5 shows all the values of Q^2 range from 0.131 to 0.411 (greater than 0), this indicates that there is an adequate predictive relevance for the proposed model. For the Q^2 values, Hair et al., (2017) suggest values of 0.35 (large), 0.15 (medium) and 0.02 (small) as a relative measure of predictive relevance. The result of this study shows that one endogenous construct has a large predictive relevance, while the remaining have medium predictive relevance.

An issue of multi-collinearity could exist in any study. This is not desirable, as it means that the variance exogenous constructs explained in the endogenous construct are overlapping with each other and thus not explaining any unique variance in the endogenous variable (O'brien, 2007). To measure and assess the degree of multi-collinearity, a variance inflation factor (VIF) is widely used (O'brien, 2007). There is cause for concern when the largest VIF is greater than 10 (Bowerman, 1990; Myers, 1990). And according to Hair et al. (2017), a multi-collinearity issue exists when the largest VIF is greater than 5. Table 5 shows a multi-collinearity diagnostic through VIF which indicates that there is no evidence of significant multicollinearity among the study exogenous constructs because all VIF values are less than 5 (ranging from 1.353 to 1.960). This means that the variance of exogenous constructs explained in the endogenous construct are not overlapping with each other.

4.3.2. Importance-performance map analysis (IPMA)

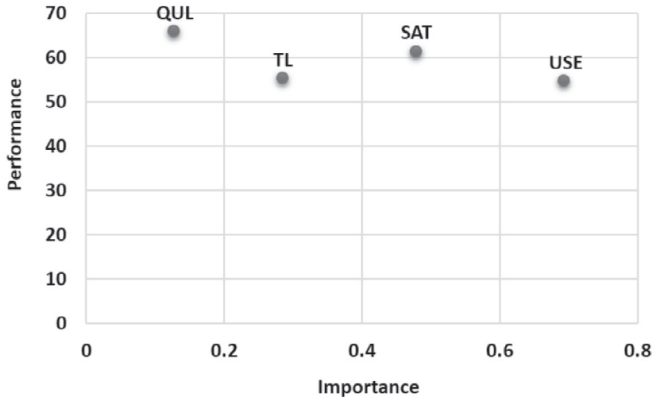
This study ran an importance-performance matrix analysis (IPMA) as a post-hoc procedure in PLS using performance impact as the outcome construct. The IPMA estimated that the total effects represent the predecessor constructs' importance in shaping the target construct (performance impact), while their average latent variable scores represent their performance. The computation of the index values (performance scores) was accomplished by rescaling the latent constructs scores to a range of 100 (highest performance) down to 0 (lowest performance) (Hair et al., 2017). According to Ringle & Sarstedt (2016), IPMA enriches the PLS analysis results. Instead of only analyzing the path coefficients (i.e. the importance dimension), it also takes into consideration the average value of the latent constructs and their indicators (i.e. performance dimension). Table 6 shows the findings of importance (total effects) and performance (index values) used for the IPMA.

As shown in Fig. 3 this study plotted the total effects scores and index values in a priority map, and it can be observed that actual usage of online learning is a very important factor in determining performance impact due to its relatively higher importance values compared to other constructs in the proposed model. User satisfaction is the second important factor in determining the performance impact.

Nevertheless, the performance of this significant factor (actual usage) lagged behind other factors (overall quality, TL). According to Hair et al. (2017), The goal of IPMA is to identify predecessors that have a relatively high importance for the target construct (i.e., those that have a strong total effect) but also a relatively low performance (i.e., low average latent variable scores). The aspects underlying these constructs represent potential areas of improvement that may need to receive high attention.

Table 6
IPMA for performance impact.

Latent constructs	Total effect of the construct performance impact (Importance)	Index values (Performance)
Overall Quality (QUL)	0.127	66.02
Transformational Leadership (TL)	0.284	55.28
Actual Usage (USE)	0.693	54.77
User Satisfaction (SAT)	0.479	61.3



Key: QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction.

Fig. 3. IPMA (Priority Map) for performance impact. Key: QUL: overall quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction.

In sum, in order to improve the performance impact, the managerial activities should focus on enhancing the performance of actual usage of online learning.

5. Discussion

Based on the extended DMISM, this study improves the understanding of the roles played by TL and compatibility in the process of online learning adoption and usage among students from nine public universities in Yemen, and hence highlights relevant implications and suggestions for university lecturers and policy makers to realise the outcome of online learning. The discussions are further detailed in the following.

The study found that overall quality has a significant positive effect on transformational leadership, indicating that the higher the quality of online learning in terms of easiness, flexibility, up-to-date, accuracy, relevance, comprehensiveness, responsiveness, functionality and interactivity, the more likely lecturers and university lecturers will encourage the use of online learning, which means that university lecturers would not be able to encourage, motivate, and inspire students to use online learning unless adequate quality exist in terms of system, information, and service.

The results also revealed that transformational leadership has a significant positive effect on actual usage, indicating that the more students are inspired, motivated and encouraged to utilise online learning and have their efforts recognised, the higher frequency and duration of student online learning use will be. This is in line with prior studies (Cho et al., 2011; Ghazali et al., 2015). At the same time, this study reveals that overall quality has an indirect effect on actual usage of online learning among students in nine public universities in Yemen via transformational leadership. Simply stated, the more online learning is flexible, easy to use, provides up-to-date information, is accurate, interactive, responsive and reliable, the more students increase the frequency and duration of their usage of online learning, more so when they are encouraged, motivated and have their efforts recognised by university lecturers.

With regard to the effect of actual usage on user satisfaction, the results showed that actual usage has a significant effect on user satisfaction, and this is consistent with previous studies (Culibrk et al., 2016; Isaac et al., 2017a–e; Norzaidi, 2008), and explained by the notion that when actual usage of online learning among students of public universities in Yemen increases, their satisfaction improves, which can be understood as the more students increasingly got familiar with online learning usage and realizing its benefits, the more they become satisfied with their decision to use online learning in their learning process.

The effect on performance impact by actual usage and user satisfaction of online learning respectively confirmed that actual usage significantly predicts performance impact, also in line with prior studies (Hou, 2012; Islam, 2015; Kim et al., 2015). Similarly, it was found that user satisfaction positively influences performance impact as found by previous studies (Abrego-Almazán et al., 2017; Aparicio et al., 2017; Isaac et al., 2017b), where the more satisfied students are in terms of valuing the content and believing they have taken a wise decision to use online learning, the greater is the impact on their academic performance. When students in public universities in Yemen increase the frequency and duration of their online learning usage and have a prior satisfaction with the system, their performance is enhanced in three areas: efficiency (accomplish tasks quickly, accomplish tasks easily, and save money), knowledge acquisition (acquire new knowledge and skills, come up with innovative ideas, and be helped to learn) and productivity (learning performance and academic productivity). There is also a moderate enhancement in a fourth area, that of competence (eliminate errors and realise future targets).

There are some contradictory opinions. Wu & Wang (2006) reported that actual usage has no significant impact on perceived benefit, Khayun & Ractham (2011) indicated that there is no relationship between actual usage and performance impact, and Cho et al. (2015) concluded that actual usage does not predict performance impact. These results may be explained by their use of differing study settings and variables that are meant to measure actual usage.

According to importance-performance map analysis, actual usage is the prime key antecedent that can make a significant effect on

performance impact, followed by user satisfaction, TL and then overall quality. Thus, policy makers should give priority to usage duration and frequency when promoting and implementing online learning within public universities in Yemen.

6. Implications

6.1. Implications for research

Online learning has been extensively studied in terms of adoption and this study offers an insight into a post usage model. In addition to successfully extending the Delone & Mclean information success model, it has been applied to a new setting and context, namely online learning in Yemen. Further, this study has validated a second-order model of overall quality for the purpose of increasing the power of actual usage, one which contains three first-order constructs (system quality, information quality, and service quality). The Delone & Mclean information success model has been extended by adding transformational leadership as a mediating variable in order to create a rigid model to be used in new contexts. Also in this study, 61% of the performance impact variance was explained, and the predictive power of this model, which includes transformational leadership, has a greater capability to explain and predict performance impact compared to models from some previous studies, where the performance impact variance explained was 46% (Khayun & Ractham, 2011), 42% (Xinli, 2015), 40% (Wang & Liao, 2008), and 37% (Hou, 2012). This study provides evidence that the proposed model can be more effective in explaining performance impact, especially within the online learning context, than other models in the previous literature.

6.2. Implication for practice

Yemen is faced with difficult challenges in the education sector. According to The Global Competitiveness Report (2017), Yemen ranked as 116 out of 138 countries in the world in terms of tertiary education enrolment rate. There is also a gender gap in the enrolment, based on Yemeni educational indicators (2015), where the number of female students enrolled in public universities in Yemen lags behind the male by 50% (M = 148834, F = 78329). Online learning can play a major role in facing such a challenge, because according to UNESCO (2013), among the main features of online learning is its ability to expand the reach and equity of education.

Although Yemen is a low-income developing country with limited resources (World Development Indicators, 2017), and is significantly behind in adoption of internet which is considered one of the greatest inventions of this generation (Hypponen, 2013). Moreover, low internet penetration problem is hindering economic, social and political development (Oyedemi, 2012). Studies have shown that technology usage is linked to national income (Pew Research Center, 2013), positively influences organizational performance (Wang & Hou, 2003; Chen, 2008), and significantly impacts individual performance (Simsim, 2011). Further, Yemen can take advantage of the benefits of online learning to provide high quality education despite limited resources (Dokhan & Akkoyunlu, 2016; and Yang et al., 2016). Online learning can improve communication and administration, enable anytime and anywhere learning and promote equity of education.

The implications of the key findings provide significant benefits, not only for individuals, but also for the Yemeni public sector and the country as a whole, if they can adapt and promote online learning. Students in this study generally agreed that using online learning helped (1) improve their learning performance, (2) enhance their knowledge acquisition, (3) enhance academic effectiveness, and (4) helped them to come up with innovative ideas. This will ultimately create a productive individual that will benefit the country as a whole.

The findings of this study can be very useful for the Yemeni Centre for Information Technology in Higher Education (YCIT-HE) which was established to be an enabling authority for the provision of information technology services for students and academic and management staff in Yemeni universities by highlighting the important factors and the ability of new technology to address the many problems facing the higher education sector. YCIT-HE encourages and supports the execution of the Yemeni higher education master plan at both organisational and national level (Al-Madhagy, 2013).

The results also revealed that TL was an important factor in the relationship between overall quality and actual usage, and therefore it is important for university lecturers to motivate, inspire and encourage students to increase their online learning usage. Studies show that online learning can play an important role in enhancing education quality and maximising cost-efficiency (Chang, 2015; and Shukor et al., 2015).

7. Limitations and suggestions for future work

Even though this study offers positive new insights for both practice and theory, it does face limitations in three aspects. Firstly as the study population only involved students from nine Yemeni public universities, it excluded academics and administrative staff. Secondly, the research was cross-sectional, and while gaining experience in using online learning will change student beliefs, this cannot be tracked with a cross-sectional study. Thirdly, the study depended on self-reported measures to test the proposed research model because getting objective data about performance was not possible due to the issue of privacy. These limitations could decrease the relevance of the findings to alternative contexts, and as such, should be viewed with caution.

Researchers could test the outcome through organisational rather than individual performance. A moderating role of culture in

terms of collectivism/individualism could also exist, which makes it viable area for researchers to explore. As technology is advancing rapidly, it could be beneficial to validate the findings in longitudinal settings to explore how technological innovation influences online learning use.

8. Conclusion

The continuing advance of online technology has had a significant impact on education delivery and is shaping the way that future learning will be conducted. In trying to solve the problems faced by the Yemeni higher education sector in terms of growing student population, weak infrastructure, low-quality education, and limited resources (Alrajawy et al., 2016; Isaac et al., 2016b), this research examined the mediation role of transformational leadership in the Delone & Mclean information system success model among students from nine public universities in Yemen. The results revealed that the proposed framework was successful in demonstrating the constructs of the impact on student academic performance using online learning. The study also found that transformational leadership plays a significant role in predicting actual usage of online learning, besides significantly mediating the relationship between overall quality and actual usage. This indicates that practitioners should focus on such a factor to maximise the chance of a better performance. Finally, these findings can provide significant support to Yemeni government initiatives in the higher education sector to create an environment in which students are more likely to use online learning, enhancing their academic professionalism and ultimately the quality of their working life. The implications of this study from the perspective of research and practitioners have been deliberated, limitations have been noted and some directions for future research included.

Appendix A. Instrument for varibles

Varible	Measure	Source
System Quality (SYSQ)	SYSQ1: I find the online learning to be easy to use. SYSQ2: I find the online learning to be flexible to interact with. SYSQ3: My interaction with the online learning is clear & understandable.	(Zhou, 2011; Mohammadi, 2015; Ngai, Poon, & Chan, 2007)
Information Quality (INFQ)	INFQ1: Online learning provides up-to-date knowledge. INFQ2: Online learning provides accurate knowledge. INFQ3: Online learning provides relevant knowledge. INFQ4: Online learning provides comprehensive knowledge. INFQ5: Online learning provides organized knowledge.	(Lin & Wang, 2012; Lin, Fofanah, & Liang, 2011; Mohammadi, 2015)
Service Quality (SERQ)	SERQ1: I could use the online learning services at anytime, anywhere I want. SERQ2: Online learning offers multimedia (audio, video, and text) types of course content. SERQ3: Online learning enables interactive communication.	(Lin, Fofanah, & Liang, 2011; Pituch & Lee, 2006)
Transformational Leadership (TL)	TL1: University lecturers enable students to think about learning and academic assignments in new ways. TL2: University lecturers encourage and inspire students to use online learning. TL3: University lecturers concern and recognize students' efforts of use online learning. TL4: University lecturers use the internet as a helping tool for teaching and communicate students.	(Elkhani, Soltani, & Nazir Ahmad, 2014; Garcia-Morales et al., 2008)

Actual usage (USE)	USE1: On average, how frequently do you use the online learning? - Certainly not - Less than once a month - Once a month - A few times a month - A few times a week - About once a day - Several times a day USE2: On average, how much time do you spend per week using the online learning? - Certainly not - Almost never - less than 2 h - 2–4 h - 4–6 h - 6–8 h - More than 8 h	(Kim et al., 2007a,b)
User Satisfaction (SAT)	SAT1: My decision to use the online learning was a wise one. SAT2: The online learning has met my expectations. SAT3: Overall, I am satisfied with the online learning.	(Sun, Tsai, Finger, Chen, & Yeh, 2008; Wang, 2008; Huang, 2008)
Performance impact (PI)	PI1: Online learning helps me to accomplish my tasks more quickly. PI2: Online learning makes it easier to complete my tasks. PI3: Online learning saves my money. PI4: Online learning improves my learning performance. PI5: Online learning enhances my academic effectiveness. PI6: Online learning helps reviews and eliminate errors in my work tasks. PI7: Online learning helps me to realize my future target. PI8: Online learning helps me acquire new knowledge. PI9: Online learning helps me acquire new skills. PI10: Online learning helps me to come up with innovative ideas.	(Isaac et al., 2017a–e; Kim et al., 2007a,b; Khayun & Ractham, 2011; Gbenga et al., 2013; Datta, 2011; Wu & Wang, 2006; Liu, Li, & Carlsson, 2010; Wu & Wang, 2006)

Appendix B. Results of discriminant validity by the cross loading

	SYSQ	INFQ	SERQ	TL	USE	SAT	PI
SYSQ1	**0.872**	0.655	0.508	0.290	0.425	0.470	0.432
SYSQ2	**0.885**	0.580	0.498	0.328	0.471	0.526	0.459
SYSQ3	**0.871**	0.650	0.500	0.342	0.493	0.535	0.480
INFQ1	0.656	**0.857**	0.603	0.335	0.528	0.545	0.566
INFQ2	0.576	**0.823**	0.446	0.342	0.412	0.451	0.486
INFQ3	0.581	**0.850**	0.582	0.371	0.502	0.559	0.549
INFQ4	0.621	**0.864**	0.552	0.332	0.406	0.496	0.491
SERQ1	0.512	0.564	**0.894**	0.380	0.397	0.495	0.494
SERQ2	0.522	0.588	**0.915**	0.332	0.445	0.503	0.517
SERQ3	0.504	0.581	**0.874**	0.369	0.481	0.503	0.567
TL1	0.309	0.355	0.351	**0.839**	0.347	0.426	0.422
TL2	0.297	0.325	0.330	**0.879**	0.347	0.456	0.412

TL3	0.310	0.338	0.340	**0.847**	0.342	0.428	0.388
TL4	0.316	0.355	0.339	**0.811**	0.347	0.443	0.384
USE1	0.493	0.499	0.458	0.388	**0.923**	0.602	0.656
USE2	0.479	0.506	0.449	0.365	**0.917**	0.601	0.619
SAT1	0.530	0.559	0.539	0.470	0.620	**0.925**	0.692
SAT2	0.574	0.592	0.544	0.506	0.621	**0.926**	0.679
SAT3	0.508	0.526	0.463	0.463	0.569	**0.921**	0.644
PI1	0.452	0.542	0.496	0.454	0.612	0.637	**0.860**
PI2	0.469	0.556	0.522	0.439	0.603	0.636	**0.871**
PI3	0.450	0.513	0.508	0.366	0.562	0.601	**0.817**
PI4	0.476	0.556	0.537	0.423	0.589	0.644	**0.870**
PI5	0.455	0.517	0.499	0.408	0.591	0.642	**0.871**
PI6	0.481	0.547	0.503	0.428	0.592	0.648	**0.852**
PI7	0.436	0.525	0.504	0.428	0.617	0.597	**0.852**
PI8	0.417	0.516	0.512	0.427	0.610	0.619	**0.862**
PI9	0.404	0.508	0.493	0.336	0.593	0.593	**0.862**
PI10	0.421	0.503	0.456	0.355	0.562	0.605	**0.838**

Key: SYSQ: system quality, INFQ: information quality, SERQ: service quality, TL: transformational leadership, USE: actual usage, SAT: user satisfaction, PI: performance impact.

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