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Towards a Better Understanding of Internet Technology Usage by Yemeni Employees in the Public Sector: An Extension of the Task-Technology Fit (TTF) Model

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Abstract: Internet technology has changed everyday life and significantly impacted every facet of operations in organizations. However, there are developing countries such as Yemen which have very low internet usage rates and which see little economic, social and cultural progress as a result. Many scholars have studied and proposed theories and models to predict and explain user behaviour with technology seeking to understand ambiguities in technology usage. In the context of its use by organizations, actual usage is not enough to give a full picture without taking into consideration whether the technology fits with tasks or not. This study addresses this and investigates the Task-Technology Fit (TTF) and actual internet usage as a way to measure the effectiveness of information systems. It applies the TTF model as underpinning theory, extends it with two antecedent variables (i.e., organizational and social characteristics) and deals with the outcome variable (performance impact) as a second-order model containing four first-order constructs (i.e., job process, knowledge acquisition, communication quality and decision quality). A survey questionnaire was used to collect primary data from 530 internet users among employees within government ministries in Yemen. The analysis included Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) via AMOS and the results showed that the data fit the extended TTF model well. The findings of the multivariate analysis achieved three main results: first, the antecedent variables (task, technology, individual and social characteristics) have a positive impact on TTF; second, the outcome variable (performance impact) is positively influenced by TTF and actual internet usage and third, the TTF has a strong positive impact on actual internet usage. Theoretical and practical implications were also examined.

Key words: Task-technology fit, TTF, internet usage, performance impact, Yemen

INTRODUCTION

Internet technology become one the essential technological tools for individuals, organizations and nations in terms of their growth and prosperity and around 40% of the world population is connected to the internet today. However, in developing countries usage is still low. For example, Yemen has one of the lowest internet usage rates in the world at 24.70% (Fig. 1). While organizations around the world are keeping up to date with emerging technology as a driver for continuing development, one of the prime sectors affected is the public sector. According to networked readiness index, Yemeni public sector organizations lag behind most other Arab countries in Information Technology (IT) usage (Fig. 2). This lack can lead to low performance and low productivity (DeLone and McLean, 1992; Norzaidi *et al*., 2009; Makokha and Ochieng, 2014) and according to Oyedemi (2012), a low incidence of internet penetration hinders social, economic and political development.

Several theories and models have been developed to investigate and understand the characteristics related to technology usage and these have reduced the number of ambiguities affecting it and related issues. Some of the more well-known models are Technology Acceptance Model (TAM) (Davis, 1989), Task-Technology Fit (TTF) (Goodhue and Thompson, 1995), DeLone and McLean Information Systems Success Model (DMISM) (DeLone and McLean, 1992) and their updated model (DeLone and McLean, 2003) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al*., 2003). Technology and task are the main ingredients of Information System (IS) success and because of the interaction between these two essential

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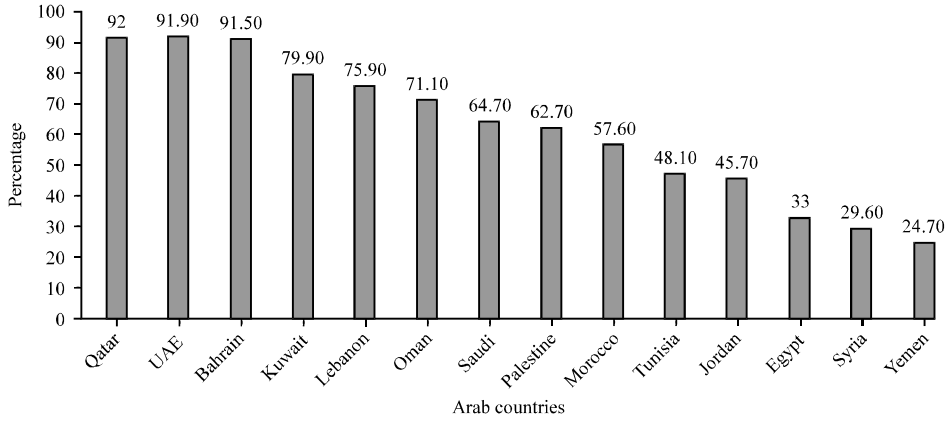


Fig. 1: Internet penetration (percentage of population use the internet) among Arab countries

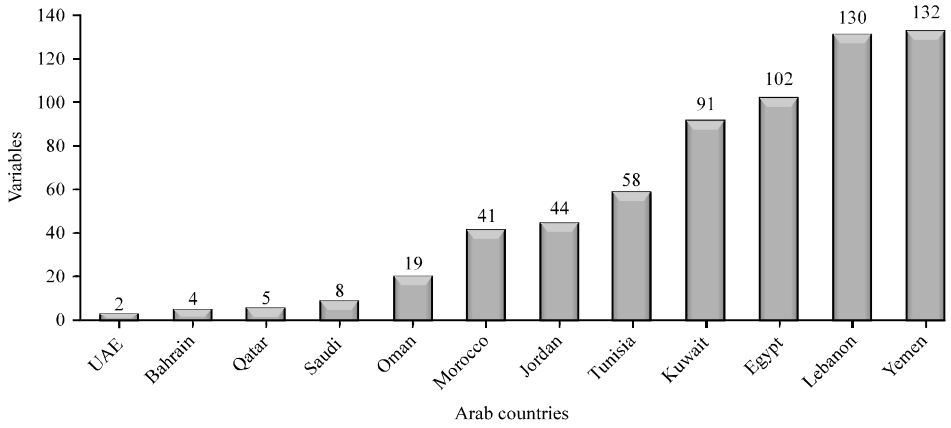


Fig. 2: Government information technology usage among Arab countries: ranked out of 143 countries

factors, new technologies have the capability to modify the nature of tasks and potentially create new tasks (Junglas *et al*., 2008). In the context of technology usage within organizations, actual usage is not enough to give a full picture without taking into consideration whether the technology fits with tasks or not (Goodhue and Thompson, 1995). TTF is considered highly imperative for the study of technology usage within organizations (D'Ambra *et al*., 2013).

The TTF model developed by Goodhue and Thompson (1995) confirmed the relationship between user perception of TTF and perceived performance and suggest that when a technology provides features and support that fit the requirements of the task, this leads to enhance performance. The TTF model has achieved wide acceptance and been validated by numerous empirical studies as an accurate predictor of system usage explaining the relationship between technology usage and tasks. It holds this position for several reasons.

Firstly, scholars have obtained empirical support for the TTF model across various contexts, leading to TTF appearing in the IS literature as one of the most widely used theories for investigating system usage and for determining whether the technology fits with tasks or not. Moreover, the rapid rate of change in technology makes any study incompetent if it does not take time seriously (Ridley, 2010). TTF has already been validated and applied across contexts and time as follows:

- North American (Schrier *et al*., 2010; Smith and Mentzer, 2010; Irick, 2008; Junglas *et al*., 2008; Dishaw and Strong, 1999; Goodhue and Thompson, 1995)
- Europe (Vogiatzi, 2015; Oliveira *et al*., 2014; Glowalla and Sunyaev, 2014; Larsen *et al*., 2009)
- Asia (Lu and Yang, 2014; Chang, 2010; Zhou *et al*., 2010; Norzaidi and Intan, 2009; Chang, 2008; Norzaidi *et al*., 2007; Lee *et al*., 2005)

- Oceania (D'Ambra *et al*., 2013; Parkes, 2013; D'Ambra and Wilson, 2004; McGill and Klobas, 2009)
- Sub-Saharan Africa (Tobias and Kairu, 2015)
- Middle East and North Africa (Bozorgkhou, 2015)

Secondly, there is a diversity of applications which support the effectiveness of the TTF model to predict user behaviour. These include: intranet technology (Norzaidi *et al*., 2007), world wide web (D'Ambra and Wilson, 2004), social networking site (Lu and Yang, 2014), online auctions (Chang, 2008, 2010), mobile commerce (Lee *et al*., 2005; Shih and Chen, 2013), cloud computing (Kang *et al*., 2013), ERP system (Glowalla and Sunyaev, 2014), internet shopping (Bozorgkhou, 2015), e-Books (D'Ambra *et al*., 2013), online user Context (Aljukhadar *et al*., 2014), management information system (Tobias and Kairu, 2015) and online cooperative learning systems (Chen *et al*., 2006).

Thirdly, unlike other well-known models such as TAM and UTAUT, the TTF model addresses the link between actual usage and performance impact. Evaluating is through performance impact is strongly recommended to measure its success (Montesdioca and Macada, 2015).

Although, the TTF model determines technological, individual and task characteristics as the main antecedent characteristics, it ignores the effect of other important characteristics such as social (Venkatesh *et al*., 2012; Ifinedo, 2012, 2014) and organizational characteristics (Chan *et al*., 2010; Kim *et al*., 2008) which play a major role in technology usage and the success of IS. This study closes the gap by extending the TTF model with two antecedent variables (organizational and social characteristics) and deals with outcome variable of performance impact as a second-order model containing four first-order constructs (i.e., job process, knowledge acquisition, communication quality and decision quality) in order to increase the power of explaining the output of the model. Because theories and models of technology usage do not serve equally across contexts (Kripanont, 2007; Straub *et al*., 1997) this study is one of few that applies the TTF model in the context of Yemen.

This study attempts to achieve the following research objectives: to examine the effect of task, technology, individual, organizational and social characteristics on task-technology fit. To examine the effect of task-technology fit on actual internet usage and performance impact. To examine the effect of actual internet usage on performance impact. If the result of this study finds that the main proposed variables have a significant impact on performance, recommendations on how users could use the internet efficiently and effectively will be made. This research would serve as a guidance in other sectors as long as the study is related to internet technology usage.

Literature review

Task characteristics: Tasks are broadly defined as the actions carried out by individuals in turning inputs into outputs (Goodhue and Thompson, 1995). While Kim *et al*. (2007) define task characteristics as the degree to which system users deal with ill-defined job problems and cooperate with other members to accomplish tasks, Lu and Yang (2014) regard them as user need for work or coursework. McFarland and Hamilton (2006) define it as the extent to which task is non-routine and varied and Norzaidi *et al*. (2009) consider it to be the degree to which system users deal with task equivocality, interdependence and structure. A number of studies have proven that task characteristics influence TTF including D'Ambra and Wilson (2011) in the context of World Wide Web (WWW) who found that task characteristics positively affect TTF. This is echoed by other results which found a positive relationship between task characteristics and TTF (Lu and Yang, 2014; D'Ambra *et al*., 2013; Lee *et al*., 2005; Norzaidi *et al*., 2007). Therefore, the hypothesis is proposed as follows:

- H_1: task characteristics significantly has a positive effect on task-technology fit

Technology characteristics: Goodhue and Thompson (1995) view technologies as 'tools' used by individuals in carrying out their tasks. Technology characteristics are defined as the degree to which the internet users are convinced of internet flexibility, ease of use, usefulness, enjoyment, security, price and speed (Kim *et al*., 2008; Sun *et al*., 2008; Zhao *et al*., 2011). In previous literature, system characteristics have been widely studied through different indicators such as adaptability, reliability, integration and accessibility (Sun and Mouakket, 2015), speed and price (Sun *et al*., 2008), security (Salisbury *et al*., 2001), ease of use and usefulness (Alrajawy *et al*., 2016; Mutahar *et al*., 2016; Ramayah, 2006; Ramayah and Lo, 2007; Ramayah *et al*., 2005) and up-to-date, accurate, relevant and precise (Cheng *et al*., 2008; Lederer *et al*., 2000).

There have been numerous studies conducted on the influence of technology characteristics on TTF. According to Norzaidi and Intan (2009), technology characteristics has a positive relationship with TTF in the context of internet technology among students. There are also many studies in different contexts and technological applications which have also emphasized this

(Glowalla and Sunyaev, 2014; Schrier *et al*., 2010; Shih and Chen, 2013). Consequently, the following hypothesis is proposed:

- H_2: technology characteristics has a positive effect on task-technology fit

Individual characteristics: Individual characteristics in the context of IS has been studied through different perspectives. Lai (2008), Kim *et al*. (2008), Lee and Kim (2009) examined individual characteristics through experience while (Cheng *et al*., 2013; Lu *et al*., 2005; Liu and Carlsson, 2010) investigated it through personal innovativeness with Ahmad *et al*. (2010) examining through skills and Chen (2013) and Chan *et al*. (2010) through awareness. This study follows (Cheung and Vogel, 2013; Shih and Fang, 2004) who looked at individual characteristics through self-efficacy, especially internet self-efficacy (Zhao *et al*., 2011; Torkzadeh and Dyke, 2001; Roca *et al*., 2006; Cheng, 2011). Self-efficacy defined as the degree to which a users believes that he or she has the confidence to perform a specific task/job using the system (Hsu and Chiu, 2004). In this study, internet self-efficacy is defined an individual's judgment of his/her capability to use the internet (Torkzadeh and Dyke, 2001).

Individual characteristics is considered by Khayun and Ractham (2011) as one of the most imperative factors in the context of IS. A few studies have proven that individual characteristics influence TTF. For instance, D'Ambra *et al*. (2013) in a quantitative study within the context of e-Book technology, found that individual characteristics positively affect TTF. This claim is supported by D'Ambra and Wilson (2011), although Lee *et al*. (2005) found that the construct of individual characteristics does not predict TTF. Therefore, the hypothesis is proposed as follows:

- H_3: individual characteristics has a positive effect on task-technology fit

Organizational characteristics: The organizational support construct is considered highly imperative as far as the study of technology usage within an organization (Anandarajan *et al*., 2002). In this study, organizational characteristics are defined as the degree to which system users are convinced that the resources necessary (hardware, software and knowledge) are provided by the organization (Lian, 2015; Gonzalez *et al*., 2012; Nistor *et al*., 2014). According to Cheng *et al*., 2013; Kurniawan, 2010; Nikhashemi *et al*., 2013), providing necessary resources and organizational support play a major role in the success of IS in organizations. Consequently, the following hypothesis is proposed:

- H_4: organizational characteristics has a positive effect on task-technology fit

Social characteristics: The Social characteristics is defined as the degree to which system users perceive that important others (family, friends and colleagues) believe they should use the system (Cheung *et al*., 2000; McGill and Klobas, 2009). Ifinedo (2012) defined this as the degree to which a system is compatible with beliefs, values and lifestyle while Chen *et al*. (2012) opine that social characteristics can become one of the important factors influencing the success of IS. A number of studies have been conducted on the influence of social characteristics on system usage and user satisfaction. For instance, Ogara *et al*. (2014) in a survey study among 239 students in the context of mobile instant messaging found that social presence and social influence predict user satisfaction. In addition, Cheung *et al*. (2000) in the context of internet and WWW found that there is a relationship between the social factor and system usage. This study takes this one step forward by examining the impact of social characteristics on TTF. Therefore, the hypothesis is proposed as follows:

- H_5: social characteristics has a positive effect on task-technology fit.

Task-technology fit: In this study, TTF is defined as the degree to which the system matches interests, fits (suits) with tasks and meets needs (Lin and Wang, 2012). Lu and Yang (2014) defined it as the degree to which technology assists users in performing their work or coursework. They also referred to it as the degree to which the system is suitable for helping to complete tasks and fit in accordance with task requirements (Lu and Yang, 2014). In the context of technology usage in organizations, actual usage is not enough to complete the full picture without taking TTF into consideration, i.e., whether the technology fits with the task or not (Goodhue and Thompson, 1995) and TTF is considered highly imperative when studying technology usage in organizations (D'Ambra *et al*., 2013). A number of studies have been conducted to examine the positive influence of TTF on usage behaviour. Norzaidi and Intan (2009) in the context of internet technology found that TTF significantly predicts actual usage and this is in agreement with other studies which found that the better the system matches the interests, the higher the actual system usage (D'Ambra *et al*., 2013; D'Ambra and Wilson, 2011; Norzaidi *et al*., 2007). Hence, it is hypothesized as follows:

- H_6: task-technology fit significantly has a positive impact on actual internet usage

Notable studies by Glowalla and Sunyaev (2014) and Lee and Lehto (2013) have investigated the positive influence of TTF on IS success factors such as performance impact and net benefits and these are supported by several previous studies that found a positive relationship between TTF and individual performance (D'Ambra *et al*., 2013; D'Ambra and Wilson, 2011; McGill and Klobas, 2009; Larsen *et al*., 2009; Daud, 2008; Norzaidi *et al*., 2007; Lee *et al*., 2005). Therefore, the hypothesis is proposed as follows:

- H_7: task-technology fit significantly has a positive impact on performance impact

Actual usage: According to Kim *et al*. (2008), actual usage is defined as the usage frequency of technology and usage times. For future research, the most powerful directions in the topic of technology usage is to investigate the impact of system usage on IS success factors such as performance (DeLone and McLean, 2016; Venkatesh *et al*., 2003) and a few studies have proposed a theoretical model to consider the impact of actual usage on performance (Hou, 2012; Son *et al*., 2012). In a quantitative study, Norzaidi and Intan (2009) indicate that there is a positive impact of actual usage on individual performance, a finding in common with other studies which found a significant relationship between system use and performance (Isaac *et al*., 2016; Makokha and Ochieng, 2014; D'Ambra *et al*., 2013; Hou, 2012; D'Ambra and Wilson, 2011; Wang and Liao, 2008; Fan and Fang, 2006; Lee *et al*., 2005). However, there are studies which found that actual usage does not predict performance (Cho *et al*., 2015; Khayun and Ractham, 2011; Wu and Wang, 2006). Consequently, the following hypothesis is proposed:

- H_8: actual usage of the internet has a positive effect on performance impact

Performance impact: Many of the previous studies regarding the usage and adoption of IT, focus on actual usage as an output construct (Almatari *et al*., 2012; Cheng, 2014; Cheung *et al*., 2000; Cheung and Vogel, 2013; Lee *et al*., 2010) and disregard the focus on evaluating IT usage such as performance impact (Shih and Chen, 2013), recommended by Montesdioca and Maçada (2015) to measure the success of IS. Performance impact in this study is defined as the degree to which system usage affects job process, knowledge acquisition, communication quality and decision quality (Khayun and Ractham, 2011). The measure of performance impact in the context of IS has been studied through different indicators. Norzaidi *et al*. (2007) measured it through the indicators of efficiency and effectiveness while Hou (2012) measured it through individual productivity, decision-making speed, decision-making quality, problem identification speed, job effectiveness, job performance and the extent of analysis in decision-making. This study not only evaluates IT usage through performance impact construct as an output variable but has moved forward to deal with performance construct as a second-order model containing four first-order constructs (job process, knowledge acquisition, communication quality and decision quality). This study proposes the second-order model in order to increase the power of explaining the output by using the model of performance impact. Most previous studies have only studied performance impact as one first-order construct with multiple items (Cheng, 2011; Hasim and Salman, 2010; Hou, 2012; McGill and Klobas, 2009; Norzaidi *et al*., 2007).

MATERIALS AND METHODS

The proposed research model: For its underpinning theory this study has applied the TTF model of Goodhue and Thompson (1995) which proposes three constructs as antecedent variables to TTF (technology, individual and task characteristics) to address the effect of TTF on actual system usage and examine the influence of TTF and actual system usage on performance. This study extends TTF model with two antecedent variables (i.e., organizational and social characteristics) and deals with outcome variables (performance impact) as a second-order model containing four first-order constructs (i.e., job process, knowledge acquisition, communication quality and decision quality) as Fig. 3 shows.

Development of instrument and data collection: A 37-item questionnaire was developed for this study, based on existing IS literature, applying the multi-item Likert scales which have been widely used in questionnaire-based perception studies (Lee *et al*., 2009). Unlike actual usage which is measured using a 5-rank scale, other variables were measured using a 7-point Likert scale with 7 being 'Strongly Agree' and 1 being 'Strongly Disagree'. This study also included a pre-test administered to 25 university students from Yemen to resolve any ambiguity associated with wording or measurement. The

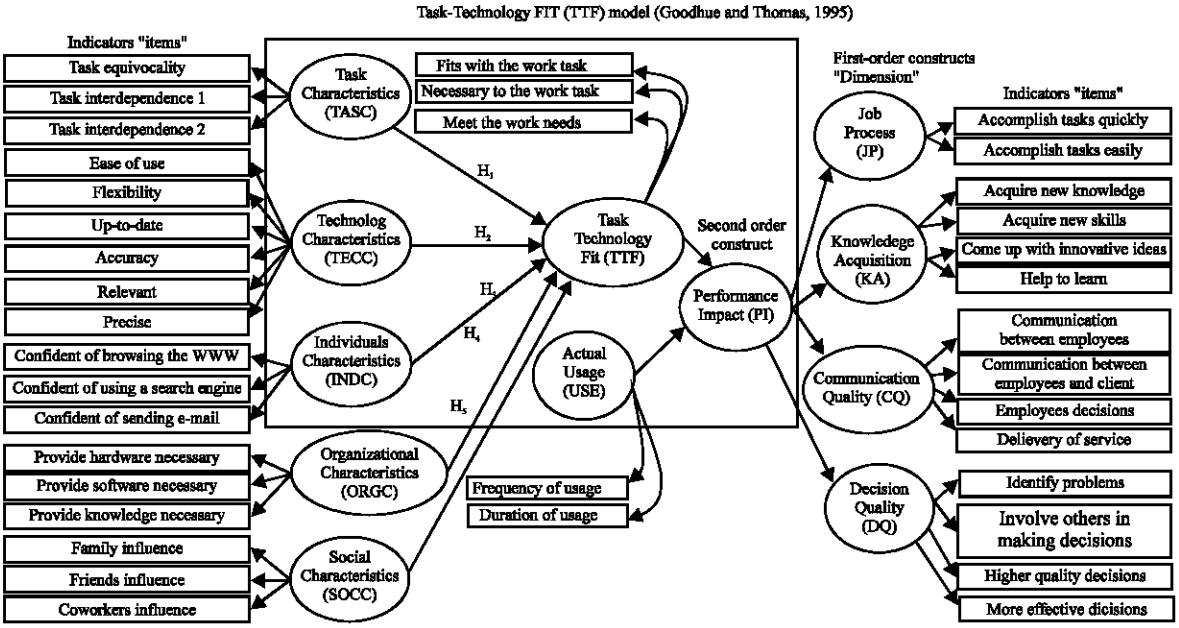


Fig. 3: Proposed extended TTF model

questionnaire was also pilot-tested to examine its internal consistency. The targeted population at the time of this study was approximately 6,090 Yemeni internet users employed in head offices in all 30 government ministries called Dwa'win. An adequate sample size for each ministry was selected based on the total number of employees.

In this study, data was collected using a self-administered study questionnaire. It was delivered to the human resource department in each ministry head office, then one department employee together with the researcher were responsible for personally distributing the questionnaires to the those employees who use the internet during working hours. Before, the end of official working hours, the questionnaires were collected directly. A total of 700 questionnaires were distributed and of the 530 sets returned, 508 responses were useful for the analysis. The final sample size was considered adequate (Tabachnick and Fidell, 2012; Krejcie and Morgan, 1970). The 76% response rate is considered as very good (Baruch and Holtom, 2008) when compared to other studies found in the relevant literature. A total of 22 questionnaires were deleted; 12 were removed because the missing data for >15% of the questions, 4 considered as outliers and 6 involving straight lining. The demographic profile of the respondents is shown in Table 1. The 412 (81.1%) were male and 96 (18.9%) female. About 1.4% were >20 years old, 28.3% between 20 and 29 years, 53.9% between 30 and 39, 12.6% between 40 and 49 and 3.7% were 50 years and above. In terms of education background, 10.4% had high school certificate, 8.7% had a diploma, 72.2% had a bachelor degree (the majority of participants) with the remaining 8.7% having finished postgraduate studies.

Table 1: Summary of demographic profile of respondents

Demographic items/categories	Frequency	Percentage
Gender		
Male	412	81.1
Female	96	18.9
Age		
<20 years	7	01.4
20-29 years	144	28.3
30-39 years	274	53.9
40-49 years	64	12.6
50 years and above	19	03.7
Education background		
High school	53	10.4
Diploma	44	08.7
Bachelor degree	367	72.2
Master degree	44	08.7
Marital status		
Single	117	23.0
Married	380	74.8
Divorced	9	01.8
Widowed	2	00.4
Department		
IT department	181	35.6
Not IT department	327	64.4

RESULTS AND DISCUSSION

Data analysis and results

Descriptive analysis: Table 2 and 3 present the mean and standard deviation of each variable in the current

Table 2: Goodness-of-fit indices for the measurement model

Fit Index	Cited	Admissibility	Results	Fit (Yes/No)
χ^2	-	-	1228.045	-
df	-	-	0597.000	-
p-value	-	>0.05	0.000	No
Relative χ^2	Kline (2010)	1-5	2.057	Yes
RMSEA	Steiger (1990)	<0.08	0.046	Yes
SRMR	Hu and Bentler (1999)	<0.08	0.049	Yes
GFI	Joreskog and Sorbom (1993)	>0.90	0.884	No
AGFI	Joreskog and Sorbom (1993)	>0.80	0.864	Yes
NFI	Bentler and Bonnet 1980)	>0.80	0.911	Yes
PNFI	Bentler and Bonnet (1980)	>0.05	0.816	Yes
IFI	Bollen (1990)	>0.90	0.952	Yes
TLI	Tucker and Lewis (1973)	>0.90	0.946	Yes
CFI	Byrne (2010)	>0.90	0.952	Yes
PGFI	James *et al*. (1982)	>0.50	0.751	Yes

χ^2 = Chi square, df = degree of feedom, CFI = Comparative-Fit-Index, RMSEA = Root Mean Square Error of Approximation, SRMR: Standardized Root Mean Square Residual, GFI = Goodness-of-Fit, NFI = Normed Fit Index, AGFI = Adjusted Goodness of Fit Index, IFI = Increment Fit Index, TLI = Tucker-Lewis coefficient Index, PNFI = Parsimony Normed Fit Index. The indexes in bold are recommended since they are frequently reported in literature (Awang, 2014)

Table 3: Mean, standard deviation, loading, cronbach's alpha, CR and AVE

Construct/Item	Loading (>0.5)	M	SD	a (>0.7)	CR (>0.7)	AVE (>0.5)
Task characteristics (TASC)						
TASC1: Task equivocality	0.71	5.423	0.953	0.798	0.804	0.580
TASC2: Task interdependence1	0.85					
TASC3: Task interdependence2	0.72					
Technology Characteristics (TECC)						
TECC1: Ease of use	0.65	5.458	1.057	0.900	0.902	0.606
TECC2: Flexibility	0.73					
TECC3: Up-to-date	0.82					
TECC4: Accuracy	0.83					
TECC5: Relevant	0.79					
TECC6: Precise	0.83					
Individual Characteristics (INDC)						
INDC1: Confident of browsing the WWW	0.72	5.056	1.341	0.804	0.810	0.588
INDC2: Confident of using a search engine	0.84					
INDC3: Confident of sending e-mail	0.74					
Organizational Characteristics (ORGC)						
ORGC1: Provides hardware necessary	0.89	4.940	1.050	0.886	0.889	0.727
ORGC2: Provides software necessary	0.85					
ORGC3: Provides knowledge necessary	0.81					
Social Characteristics (SOCC)						
SOCC1: Family influence	0.74	5.090	1.336	0.821	0.827	0.616
SOCC2: Friends influence	0.85					
SOCC3: Coworkers influence	0.76					
Task Technology Fit (TTF)						
TTF1: Fits with the work tasks	0.91	4.858	1.485	0.911	0.918	0.789
TTF2: Necessary to the work tasks	0.90					
TTF3: Meet the work needs	0.85					
Actual Usage (USE)						
USE1: Frequency of usage	0.86	3.360	1.012	0.744	0.766	0.623
USE2: Duration of use	0.71					
Performance Impact (PI)						
PI1: Accomplish tasks quickly	0.89	5.044	1.134	0.925	0.833	0.752
PI2: Accomplish tasks easily	0.87					
PI 3: Acquire new knowledge	0.87					
PI 4: Acquire new skills	0.93					
PI 5: Come up with innovative ideas	0.89					
PI 6: Help to learn	0.82					
PI 7: Communication between employees	0.85					
PI 8: Communication between employees and clients	0.85					
PI 9: Employee's discussions	0.85					
PI 10: Delivery of service	0.87					
PI 11: Identify problems	0.90					
PI 12: Involve others in making decisions	0.83					
PI 13: Higher quality decisions	0.85					
PI 14: More effective decisions	0.87					

M = Mean; SD = Standard Deviation, α = Cronbach's alpha; CR = Composite Reliability, AVE = Average Variance Extracted; TASC: Task Characteristics, TECC: Technology Characteristics, INDC: Individual Characteristics, ORGC: Organizational Characteristics, SOCC: Social Characteristics, TTF: Task-Technology Fit, USE: Actual Usage, PI: Performance Impact. The measurement used is seven-point scale ranging from 1 (strongly disagree) to 7 (strongly Agree) only actual usage used 5 ranking scale. All the factor loadings of the individual items are statistically significant ($p<0.01$). CR = $(\Sigma K^2)/(\Sigma K^2)+(\Sigma 1-K^2))$, AVE = $\Sigma K^2/n$. Where K = factor loading of every item, n = number of item in a model

study. The respondents were asked to indicate their opinion in relation to their internet usage based on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Technology characteristics recorded the highest mean score of 5.458 out of 7.0 with a standard deviation of 1.057, indicating that the respondents considered the internet as ease of use has flexibility and is up-to-date, accurate, relevant and precise. Task characteristics recorded a mean score of 5.432 out of 7.0 with a standard deviation of 0.953, indicating that the respondents believed that they frequently deal with ad-hoc, non-routine business problems and they usually have to cooperate with other members to accomplish their tasks. It can also be concluded that the level of individual characteristics in regard to the confidence of internet usage among the respondents is high. In addition, the level of social characteristics which describes the influence of family, close friends and coworkers is high. For organizational characteristics, the result show that the respondents agreed that they possess the necessary hardware, software and knowledge with a mean score of 4.940 out of 7.0 and standard deviation of 1.050 and the TTF mean score of 4.858 with a standard deviation of 1.485 indicates that a majority of employees agree that the internet fits with the work tasks. Finally, in term of performance impact the majority of respondents agree that internet usage improves their job process, knowledge acquisition and communication and decision-making quality with a mean score of 5.044 out of 7.0 and standard deviation of 1.134.

Measurement model assessment and Confirmatory Factor Analysis (CFA): All the goodness-of-fit indices as shown in Table 2 exceeded their respective common acceptance levels as suggested by previous research, thus demonstrating that the measurement model exhibited a fairly good fit with the data collected. However, in this study since GFI does not fit (0.884), Sharma *et al.* (2005) recommended that this index should not be used because of the sensitivity of the index and the fact its use is no longer popular. The Absolute fit indices show that the chi-square is not significant (p value should be >0.5). But in spite of this, the model still fits because the chi-square statistic nearly always rejects the model when large samples are used (Bentler and Bonnet, 1980; Joreskog and Sorbom, 1993). The Chi-square is sensitive to sample size >200 (Byrne, 2010) and the sample size for this study is 508. Therefore, the psychometric properties of the measurement model could be evaluated in terms of construct and indicator reliability and convergent and discriminant validity.

For construct reliability, this study tested the individual Cronbach's alpha coefficients to measure the reliability of each of the eight variables in the measurement model. The results indicate that all the individual Cronbach's alpha coefficients are greater than the recommended level of 0.7 (Kannana and Tan, 2005; Nunnally and Bernstein, 1994). In addition, in testing construct reliability, all the Composite Reliability (CR) values were higher than the recommended value of 0.7 (Kline, 2010; Gefen *et al*., 2000) which adequately indicates that the construct reliability has been fulfilled (Table 3). 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*., 2013). Factor loadings >0.50 are considered to be very significant (Hair *et al*., 2010). The loadings for all the items exceeded the recommended value of 0.5 as shown in Table 3 and therefore, the loadings for all the items in the model fulfilled all the requirements without being eliminated from the scale. This study also used Average Variance Extracted (AVE) to test convergent validity and found that all AVE values were higher than the recommended value of 0.50 (Hair *et al*., 2010). The convergent validity of all the constructs was thus successfully fulfilled and it exhibited adequate convergent validity (Table 3).

The discriminant validity of the measurement model was checked using the Fornell-Larcker criterion. As shown in Table 4, the correlations between the factors are smaller than the square root of the average variance extracted estimates. This indicates that the variables are strongly related to their respective indicators compared to other variables of the model (Fornell and Larcker, 1981), thus suggesting a good discriminant validity. In addition, the correlation between exogenous constructs is less than 0.85 (Awang, 2014). Hence, the discriminant validity of all constructs is fulfilled.

Structural model assessment: The goodness-of-fit of the structural model was comparable to the previous CFA measurement model. In this structural model, the values were recorded as Relative χ^2 = 2.946, CFI = 0.908 and RMSEA = 0.062. These fit indices provide evidence of adequate fit between the hypothesized model and the observed data (Byrne, 2010). Thus, path coefficients of the structural model could now be examined.

Hypotheses tests: The hypotheses of this study were tested using Structural Equation Modelling (SEM) via

Table 4: Results of discriminant validity by Fornell-Larcker criterion for the model

	1	2	3	4	5	6	7	8
Factors	PI	TECC	TASC	TTF	USE	SOCC	INDC	ORGC
PI	0.867							
TECC	0.626	0.778						
TASC	0.385	0.467	0.761					
TTF	0.780	0.515	0.366	0.888				
USE	0.664	0.409	0.270	0.575	0.790			
SOCC	0.447	0.494	0.286	0.350	0.343	0.785		
INDC	0.487	0.609	0.324	0.378	0.435	0.572	0.767	
ORGC	0.305	0.416	0.341	0.206	0.136	0.290	0.283	0.853

Diagonals represent the square root of the average variance extracted while the other entries represent the correlations. TASC: Task Characteristics, TECC: Technology Characteristics, INDC: Individual Characteristics, ORGC: Organizational Characteristics, SOCC: Social Characteristics, TTF: Task-Technology Fit, USE: Actual Usage, PI: Performance Impact

Table 5: Structural path analysis result

Hypothesis	Dependent variables/Independent variables	Estimate B (path coefficient)	SE	CR (t-value)	Decision
H_1	TTF<---TASC	0.17	0.088	3.705***	Supported
H_2	TTF<---TECC	0.42	0.061	9.102**	Supported
H_3	TTF<---INDC	0.10	0.057	2.108*	Supported
H_4	TTF<---ORGC	0.02	0.063	0.534	Not supported
H_5	TTF<---SOCC	0.12	0.056	2.726**	Supported
H_6	USE<---TTF	0.56	0.037	11.321***	Supported
H_7	PI<---TTF	0.60	0.025	7.035***	Supported
H_8	PI<---USE	0.31	0.025	4.825***	Supported

***,**,*p<0.001; 0.01; 0.05 , SE = Standard Error, CR = Critical Ratio; TASC: Task Characteristics, TECC: Technology Characteristics, INDC: Individual Characteristics, ORGC: Organizational Characteristics, SOCC: Social Characteristics, TTF: Task-Technology Fit, USE: Actual Usage, PI: Performance Impact

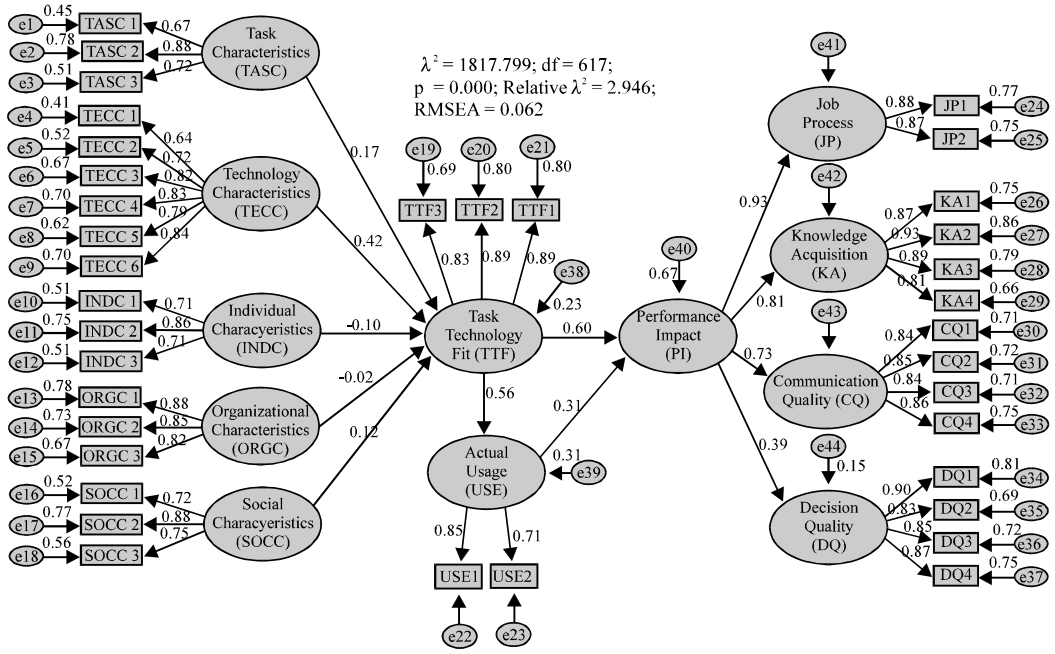


Fig. 4: Research structural model results

AMOS (Fig. 4). The structural model assessment shown in Table 5 provides the indication of the hypotheses tests with seven out of the eight hypotheses of this study being supported. The exception is H_4. Task, technology, individual and social characteristics significantly predict TTF. Hence, H_1, H_2, H_3 and H_5 are accepted with ($\beta = 0.17$, $p<0.001$; $\beta = 0.42$, $p<0.01$; $\beta = 0.10$, $p<0.05$; $\beta = 0.12$, $p<0.01$), respectively. Likewise, TTF significantly predicts actual internet usage and performance impact. Hence, H_6 and H_7 are supported ($\beta = 0.56$, $p<0.001$; $\beta = 0.60$, $p<0.001$), respectively. In addition, actual internet usage significantly predicts performance impact. Hence, H_8 is accepted with ($\beta = 0.31$, $p<0.001$). Note that the standardized path coefficient indicates the

Table 6: Coefficient of determination result R^2

Exogenous construct	Endogenous construct	R^2	Cohen (1988)	Chin (1998)	Hair *et al.* (2013)
TASC, TECC, INDC,ORGC, SOCC and USE	TTF	0.23	Substantial	Weak	Weak
TTF	USE	0.31	Substantial	Moderate	Weak
TTF and USE	PI	0.67	Substantial	Substantial	Moderate

TASC: Task Characteristics, TECC: Technology Characteristics, INDC: Individual Characteristics, ORGC: Organizational Characteristics, SOCC: Social Characteristics, TTF: Task-Technology Fit, USE: Actual Usage, PI: Performance Impact

Table 7: R^2 and factor loading for the second-order net benefits model

1st order constructs/2nd order constructs	Factor loading	R^2
JP<---PI	0.93	0.87
KA<---PI	0.81	0.66
CQ<---PI	0.73	0.54
DQ<---PI	0.39	0.15

PI: Performance Impact, JP: Job Process, KA: Knowledge Acquisition, CQ: Communication Quality, DQ: Decision Quality

strengths of the relationship between dependent and independent variables so the direct effects of technology characteristics on TTF is much stronger than other variables as evident from the values of path coefficient. On the other hand, the direct effects of TTF on performance impact is greater than the direct effect of actual internet usage on performance impact.

Coefficient of determination R^2 (the variance explained): The R^2 value indicates the amount of variance of dependent variables which is explained by the independent variables. Hence, a larger R^2 value increases the predictive ability of the structural model. It is crucial to ensure that the R^2 values should be high enough for the model to achieve a minimum level of explanatory power (Urbach and Ahlemann, 2010). Falk and Miller (1992) recommend that the R^2 values should be ≥ 0.10 in order for the explained variance of a particular endogenous construct to be deemed adequate. Cohen (1988) suggests that R^2 is substantial when it is greater than 0.26. with acceptable power above 0.02 while according to Chin (1998), R^2 is substantial when it >0.65 with acceptable power above 0.19. On the other hand, Hair *et al.* (2013) recommend that R^2 be >0.75 in order to be deemed substantial with acceptable power above 0.25. Table 6 shows the result of R^2 from the structural model, indicating that all the R^2 values are high enough for the model to achieve an acceptable level of explanatory power (Lee *et al.*, 2009, 2013).

Table 7 shows the results of R^2 and factor loading for the second-order model performance impact which load very well on three sub-constructs (job process, knowledge acquisition and communication quality) but loads weak on decision quality. Based on Chin (1998) the R^2 for the three sub-constructs (job process, knowledge acquisition and communication quality) is substantial while that for the decision quality is weak.

In this empirical study, employee usage of internet technology within public sector organizations in Yemen was analyzed. This study developed an extended model of TTF by adding two antecedent variables (i.e., organizational and social characteristics) and provides a good explanation of TTF and actual internet usage and their impact on individual performance.

This current study found that task characteristics has a positive effect on TTF. This impact is supported by previous studies (Lu and Yang, 2014; D'Ambra *et al.*, 2013; Lee *et al.*, 2005; Norzaidi *et al.*, 2007) and is explained by the fact that the more the employees have to deal with ad-hoc, non-routine business problems and interdependence, the more the internet fits with work tasks and meets the work needs for employee in the public sector in Yemen.

Technology characteristics was found to positively affect TTF. This is also supported by previous studies (Glowalla and Sunyaev, 2014; Schrier *et al.*, 2010; Shih and Chen, 2013) and the result suggests that the more employees perceive the internet as ease of use has flexibility and is up-to-date, accurate, relevant and precise, the more they find the internet fits with their work tasks and meets their work needs.

The result also showed that individual characteristics positively impacts TTF. This is explained by the fact that the more employees become confident in browsing the WWW using a search engine and sending e-mail, the greater the internet fits with their work tasks and meets their work needs. This finding is supported by previous studies (D'Ambra *et al.*, 2013; D'Ambra and Wilson, 2011). However, this result do contradict Lee *et al.* (2005) who found that there is no relationship between individual characteristics and TTF (Nikhashemia *et al.*, 2013).

Somewhat surprisingly, this study found that organizational characteristics does not influence TTF, although this contradicts the finding of Anandarajan *et al.* (2002), However, it is consistent with other researcher (Fang, 2014; Singeh *et al.*, 2013) who found that providing employees with the necessary resources is not highly imperative in the internet usage context within organizations. This result may be explained by the fact that since the majority of individuals in this age of information technology have access to the internet

through their own laptop, smartphone or similar device there is no need to provide them with hardware and software for this. Thus those involved in the studies showed more concern about task and internet technology characteristics to determine whether internet fits with tasks or not.

Social characteristics was found to positively affect TTF. This indicates that the more the family, friends and co-workers perceive that using the internet is a good idea, the more employees find the internet fits with their work tasks and meets their work needs. This is consistent with previous studies (Chen *et al*., 2012; Cheung *et al*., 2000; McGill and Klobas, 2009) which considered social characteristics as an important factor in the context of IS.

TTF was found to have a positive effect on actual internet usage. This is explained by the fact that the better the internet matches the interests of the employee, the higher the actual internet usage. This is supported by previous studies (Norzaidi and Intan, 2009; D'Ambra *et al*., 2013; D'Ambra and Wilson, 2011; Norzaidi *et al*., 2007).

This current study found that the TTF has a positive effect on performance impact and this is compatible with previous studies (D'Ambra *et al*., 2013; D'Ambra and Wilson, 2011; Daud, 2008; Glowalla and Sunyaev, 2014; Larsen *et al*., 2009; Lee and Lehto, 2013; Lee *et al*., 2005; McGill and Klobas, 2009; Norzaidi *et al*., 2007). The results indicate that when internet fits with the work tasks of employees this leads to increased performance in three dimensions improved job processes (accomplish tasks quickly and easily), increased knowledge acquisition (acquire new knowledge and skills, come up with innovative ideas and help to Learn) and improved communication quality (communication between employees, communication between employees and clients, employee discussions and delivery of service). It also moderately increases the fourth dimensions which is to improve decision quality (identify problems, involve others in making decisions and make better decisions).

Actual internet usage was found to have a positive effect on performance impact, this is supported by previous studies (Wang and Liao, 2008; Hou, 2012; Fan and Fang, 2006; Makokha and Ochieng, 2014; D'Ambra *et al*., 2013; D'Ambra and Wilson, 2011; Norzaidi *et al*., 2007; Lee *et al*., 2005). It is also explained by the fact that when employees within government institutions increase their frequency and duration of internet usage this leads to increase in their performance in three dimensions improvement in job processes, greater acquisition of knowledge acquisition and enhanced communication. It also moderately increases the fourth dimension which is better decision-making ability. Although, many studies support the positive effect of actual usage on performance impact, Wu and Wang (2006) found the opposite which is the absence of actual usage influence on perceived benefit. The contradictory findings suggest that the effect of actual usage on performance impact may be different, not only across study settings but also across variables which consider the components of actual usage and their measurements.

CONCLUSION

The internet has revolutionized the way people learn, socialize do business and govern. However, Yemen has one of the lowest internet usage rates in the world and this will hinder social, economic and political development (Oyedemi, 2012). The lack of technology usage can also lead to low performance and low productivity (DeLone and McLean, 2003; Makokha and Ochieng, 2014). In this study, the main purpose is to investigate the TTF and actual internet usage as a way to measure the IS effectiveness and investigate the antecedent variables that predicts TTF in the context of internet usage among employees in public sector organizations. The TTF model by Goodhue and Thompson (1995) was applied as an underpinning theory and the study revealed that four main constructs (task, technology, individual and social characteristics) are the main determinants of TTF. It also found that the internet fits with work tasks and greater frequency and duration of internet usage leads to increased employee performance (tasks are accomplished quickly, tasks are easier to carry out, knowledge acquisition is enhanced, communication quality is improved and decision-making is better). The findings of this study can provide policymakers with important insights on how to make a more successful approach to design and implementation of information technology within organizations and how to encourage senior management to create an environment in which employees are more likely to use the internet, enhancing their professionalism, professional development and the quality of their working life. As one of the world's least developed countries, Yemen is facing economic challenges and has one of the lowest GDP per capita (IMF, 2015), internet technology usage can play a major role in enhancing Yemen's economic growth, improving government institutions and making them more efficient while at the same time upgrading employee performance.

LIMITATIONS

The first limitation concerns the generalizability of the findings. The populations for this study are public sector Yemeni employees in the Prime Minister's Department, Government Agencies and Yemeni Ministries. However, this study focused only on in Yemeni Ministries. Another factor is that data was gathered by cross-sectional and is not longitudinal in nature. Therefore, there is ambiguity on whether usage is affected by expectations or vice versa. A third limitation is noted by Straub *et al*. (1995) who mentioned that there are biases when the researcher uses self-reported measures of usage because these are generally found to differ from the true score of system usage.

IMPLICATIONS

This study provides strong support that the TTF model predicts internet usage among employees. The present findings also add to the existing body of research by extending the TTF model with two antecedent variables (organizational and social characteristics). The extended TTF model with the outcome of usage through job process, knowledge acquisition, communication and decision quality, enhances our understanding of IT usage. This understanding can aid any effort to promote the use of the internet within organizations. In addition, future research can use the proposed model to gain a better understanding of internet usage.

The results also highlight the factors that increase employee performance and should be very useful at both the individual and organizational level for emphasising the importance of the effect of IT on the quality of work. Therefore, these findings should encourage and support the formation of future policy, not only at an organizational level but also at the national one. If the government can utilize these findings by setting up strategies to promote internet usage this may in turn, improve professional practice, personal development and the quality of working life as well as encouraging employees to make full use of the internet in their work. This research is deemed to be not only timely but also conducted in the right place. It is expected that key findings, especially the proposed model will help in supporting Yemeni government policy initiatives, especially to increase ICT usage as part of the job at all levels of organizations and develop e-Government on a national scale. The evidence shows a link between ICT usage and better performance and productivity (DeLone and McLean, 2003; Norzaidi and Intan, 2009; Son *et al*., 2012; Hou, 2012; Wang and Liao, 2008; Fan and Fang, 2006; Xinli, 2015; Khayun and Ractham, 2011). While Yemen is facing difficulties in many areas, increased ICT usage particularly through the internet can lead to social, economic and political development (Oyedemi, 2012) while such increased internet usage could be a major contributing factor for development as studies show that there is a link between internet usage and national income (PRC, 2013).

RECOMMENDATIONS

Future research should aim to apply the proposed extended TTF model with other technology applications such as mobile learning or other sectors such as the private sector. This will enhance the ability of the model to thoroughly explain actual usage and its outcome in the IS context. The organizational characteristics variable was not found to be an important factor in predicting TTF in this study. Therefore, future research should be conducted to investigate the impact of organizational characteristics on TTF by conducting cross-cultural studies.

APPENDIX

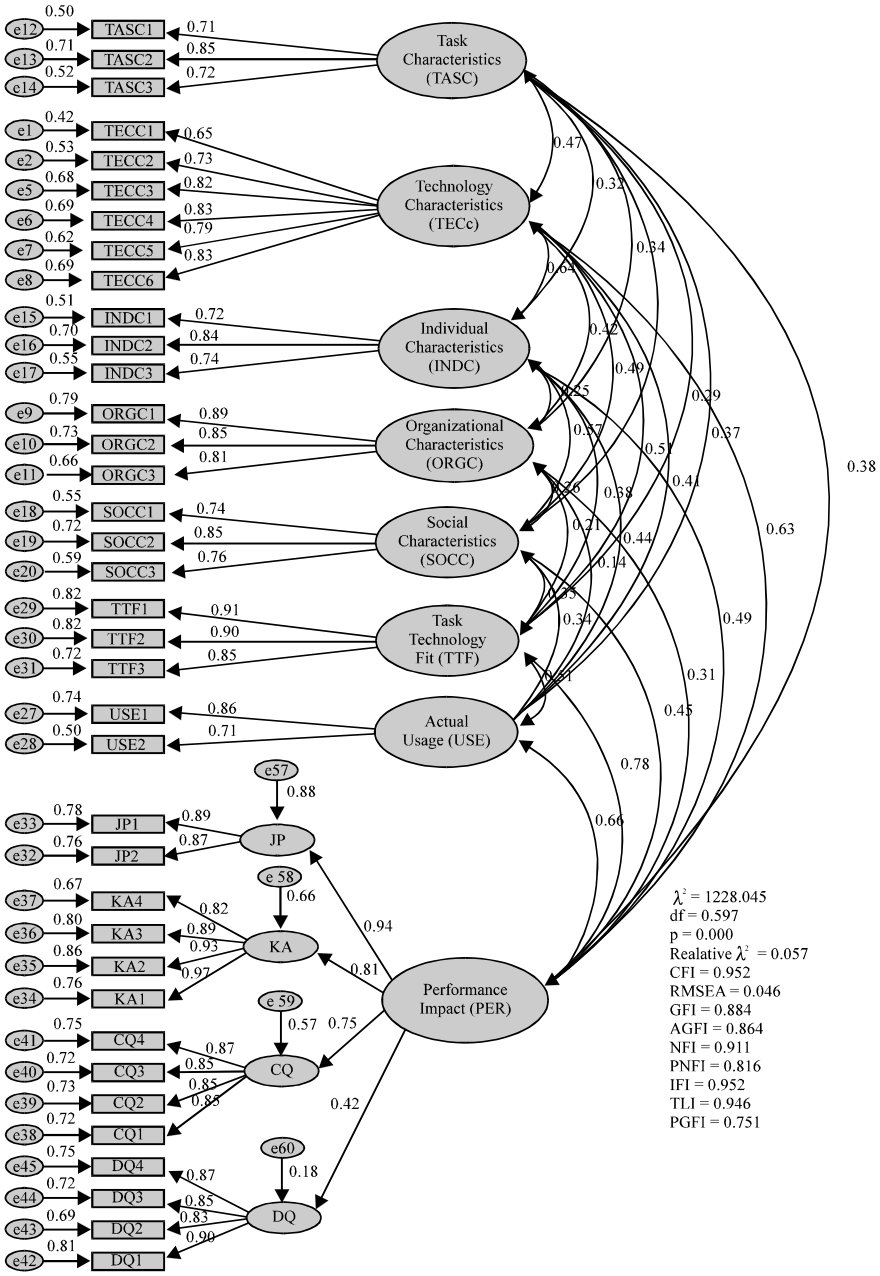
Appendix A: Instrument for task characteristics

Item	Measure	Rating scale	Sources
TASC1	Task equivocality: i frequently deal with ad-hoc, non-routine business problems	7-point Likert scale: from 1 strongly disagree to 7 strongly agree	Kim *et al*. (2008), Lee *et al*. (2011), Lee and Kim (2009), Norzaidi *et al*. (2007) and Norzaidi *et al*. (2009)
TASC2	Task interdependence1: i usually have to cooperate with other members to accomplish my tasks		
TASC3	Task interdependence2: the way I perform my job will have obvious effects on the performance of other members		
Instrument for technology characteristics			
TECC1	Ease of use: i find it easy to use the Internet to find what I want	7-point Likert scale: 1 strongly disagree to 7 strongly agree	Venkatesh and Morris (2000), Kim *et al*. (2008), Zhao *et al*. (2011) and Yu (2012), Lederer *et al*. (2000) and Cheng *et al*. (2013)
TECC2	Flexibility: i find the Internet to be flexible to interact with		
TECC3	Up-to-date: internet provides up-to-date information		

Appendix A: Continue

Items	Measures	Rating scales	Sources
TECC4	Internet provides accurate information (Accuracy)		Wang and Liao (2008)
TECC5	Internet provides relevant information (Relevant)		
TECC6	Internet provides the precise information i need (Precise)		
Instrument for individual characteristics			
INDC1	Confident of browsing the WWW I feel confident browsing the World Wide Web (WWW)	7-point Likert scale: from 1 strongly disagree to 7 strongly agree	Zhao *et al.* (2011), Cheng (2011)
INDC2	Confident of using a search engine i feel confident finding information by using a search engine (e.g., Google)		
Instrument for individual characteristics			
INDC4	Confident of sending e-Mail I feel confident sending and receiving e-Mail messages		
Instrument for organizational characteristics			
ORGC1	Provides hardware necessary: organization provides the hardware necessary to use internet	7-point Likert scale: from 1 strongly disagree to 7 strongly agree	Pai and Huang (2011), Lee and Kim (2009), Lian (2015) and Nistor *et al.* (2014)
ORGC2	Provides software necessary: organization provides the software necessary to use internet		
ORGC4	Provides knowledge necessary: organization provides the knowledge necessary to use the internet		
Instrument for social characteristics			
SOCC1	Family influence: my family thinks that using the Internet is a good idea	7-point Likert scale: from 1 strongly disagree to 7 strongly agree	Pahnila *et al.* (2011), Venkatesh *et al.* (2012) and Cheng *et al.* (2013)
SOCC2	Friends influence: my close friends think that using the Internet is a good idea		
ISOCC4	Coworkers influence: my coworkers think that using the Internet is a good idea		
Instrument for task-technology fit			
TTF1	Fits with the work tasks internet services fit with the way I accomplish my work tasks	7-point Likert scale: 1 strongly disagree to 7 strongly agree	Lee and Lehto (2013), Larsen *et al.* (2009), Lu and Yang (2014)
TTF2	Necessary to the work tasks internet services are necessary to my work tasks		
TTF3	Meet the work needs internet services meet my work needs		
Instrument for performance impact			
PI1	Accomplish tasks quickly internet helps me to accomplish my tasks more quickly	7-point Likert scale: 1 strongly disagree to 7 strongly agree	Hou (2012), Norzaidi *et al.* (2007), Norzaidi *et al.* (2009), McGill and Klobas (2009) Princely (2014) Lwoga (2013)
PI2	Accomplish tasks easily using internet make it easier to complete my tasks		
PI3	Acquire new knowledge internet helps me acquire new knowledge		
PI4	Acquire new skills internet helps me acquire new skills		
PI5	Come up with innovative ideas internet helps me to come up with innovative ideas		
PI6	Help to learn internet helps me to learn		
PI7	Communication between employees the use of internet improves communication between employees		
PI8	Communication between employees and clients the use of Internet improves communication between the employees and the clients		
PI9	Employee's discussions the use of internet improves employee's discussions		
PI10	Delivery of service the use of internet improves the delivery of service		
PI11	Identify problems internet helps me identify problems		
PI12	Involve others in making decisions internet helps me involve others in making decisions		
PI13	Higher quality decisions internet helps me make higher quality decisions		
PI14	More effective decisions internet helps me make more effective decisions		

Instrument for actual usage: Items measure of this variable as follow adapted from (Shih and Fang, 2004); USE 1 (Frequency): How often do you use the internet? Don't use, once each month, once each week, once each day, several times in day; USE 2 (Time): How often do you use the internet each time? Don't use, <1, 1-2 , 3-4 , >5 h



Appendix B: Final result of CFA

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