Exploring the Underlying Technological Factors and E-government Readiness Constructs among the Technical Staff at the Ministry of Communications and Informatics in Libya

Asma Ali Mosa Eltharif
Computer Department
Education Faculty
Universality of Benghazi
Benghazi, Libya

Mustafa Omar M. Baeuo
Education Technology Department
Education Faculty
Universality of Benghazi
Benghazi, Libya

Eslam Ali Eldharif
Computer Science Department
Faculty of Information Technology University of Benghazi
Benghazi, Libya

ABSTRACT
The aim of this study was to explore the underlying technological factors and e-government readiness constructs among the technical staff at ministry of communications and informatics in Benghazi city and Tripoli city in Libya and to validate the psychometric properties of e-government readiness constructs in terms of their reliability, convergent and discriminant validity. The sample consisted of 380 respondents and questionnaires were sent out to technical staff at Ministry of Communications and Informatics. The returned survey instruments 369, out of which, 16 where not com filled up as required and disregarded from data capture with exploratory factor analyses. The results yielded 8 factors which are: Computer resources i.e. software and hardware, Data centres, security, technological expert support, operational, Communication and e-government readiness. The study revealed that the construct of technological factors and e-government readiness is a valid and reliable multidimensional one. The findings are therefore useful as evidence for making informed decisions for those involved in developing e-government system in Libya and also for informing future research in this area.

Keywords
E-government, Ministry of communications and Informatics, Exploratory Factor Analyse

1. INTRODUCTION
With the advent of the Internet and online technology new frameworks of doing business have emerged. Governments beside any other business companies have experimented with these various frameworks with varying degrees of success. According to Poostchi [18] the governments are not immune to these changes and are under increasing pressure to change their traditional business framework to what is commonly referred to as "E-government - Electronic Government", with ready access to information, increased self-service options for citizens and businesses, and increased accountability and democracy. In this regards, e-government has been has become a major issue of modernization and government reform programs. In short, e-government is the use of information and communications technology (ICT), such as the Internet, to enhance the government processes [6]. E-government facilitates the improvement of the quality of service provided to the citizen by getting service or information in minutes or hours instead of days or weeks.

E-government helps employees of government to perform their work easily in efficient and effective way comparing to employees in the commercial world [16]. E-government improves the efficiency and effectiveness of government functions and is a strong driver for resources allocation and sharing (information, services and business process) and for standardization of organizational, legal, and technical frameworks [15]. Conventionally, e-government increases the operation efficiency to serve citizens better by providing information and services to citizens online 24 hours a day with low costs, and it helps to reduce over-stretched bureaucratic system. E-government provides several services such as paying traffic tickets, fine, bills, voter information, birth & death certificates, health & education services and more. E government can also expanded to conduct transactions with business partners such as suppliers, vendors and contractors [16].

2. MOTIVATION AND RELATED WORK
Arab countries started to implement e-government programs but in different degrees. However, government services implementation is still in its very early stages and has not been utilized to full extent or potential in most of the Arab counties [2]. Some of them made positive strides compared to other countries of the world such as the United Arab Emirates, Bahrain, Saudi Arabia and Qatar. Others is on the right track for implementing e-government program such as Tunisia, Egypt and Jordan, while there are some countries still in its first steps, such as Iraq and Libya. The e-government in Libya did not achieve tangible progress due to the conditions experienced, which led to regime change. The new Libyan government has begun seriously after 2011 to create and prepare the requirements for developing effective e-government program as a significant tool to develop economy. The government departments must initiate programs to transform all governmental transactions into digital deals on the Internet. On the other hand, citizens should experience the ease of use, saving time and financial by using e-government services [8]. However, the preparedness of government, to make transformation to e-government is affected by a set of divergent factors [11]. In this regard, this paper explores the underlying technological factors and e-government readiness constructs among the technical staff at ministry of communications and informatics in Benghazi city and Tripoli city in Libya.

In Libya, the government controls most of economic activities; hence it should exploit modern technology to enhance services

quality and quantity. Since the launch of Libyan government website in June 2005, it initially targets a few key services such as providing information about legislative, law, some government activities [20]. Alongside the limited services, ICT's transformative potential in Libya is also limited by its existing reach and use. The Internet penetration rate, however, was only 14 percent, which is lower than many other countries in the region [11]. This low rate is due to the problem of resistance to change and the high cost of using new technologies. Compared with other countries, access costs are high, which has a negative impact on the efficient use of the network within Libyans. There is a lack in number of telephone lines, which represents one of the main barriers to Internet use [20]. However; mobile phones offer a good opportunity for accessing the Internet, where many users access the Internet primarily through their mobile devices. In addition to the poor infrastructure in Libya, security is also one of the main technical issues that e-government faces. The Libyan government has still not yet formulated e-government services and e-business laws, such as laws for incorporating digital signatures [1]. Thus, this study aims primarily to explore the underlying technological factors and e-government readiness constructs among the technical staff at ministry of communications and informatics in Libya. This paper will answer the following research questions:

- What are the underlying technological factors and e-government readiness constructs among the technical staff at ministry of communications and informatics in Libya?
- Are the technological factors and e-government readiness constructs psychometrically valid in terms of their reliability, convergent and discriminant validity?

3. RESEARCH METHODOLOGY

The Research design involves using different approaches to solve the research problem and achieve its objectives. The research design helps to understand the total research work easily and systematically. This study employs a survey method to gather the information from the respondents. The total number of 380 questionnaires were sent out to technical staff at Ministry of Communications and Informatics in Benghazi city and Tripoli city, and faculty members of Faculty of Engineering and Faculty of Information Technology University of Benghazi, Tripoli, Al-Marqab, and Misurata. The returned survey instruments 369, out of which, 16 where not com filled up as required and disregarded from data capture with SPSS. The final data captured analysis therefore was based on of 353 questionnaires that were deemed valid, accounting for 92% of response rate. In light of the guidance offered by Sekaran and Bougie [19] and Chatman [4, 5], a response rate of 30% or more is considered acceptable. In the current study, 92% response rate therefore was in line with the established guidelines. A random sampling technique is adopted for questionnaire distribution.

Table 1. Questionnaire Distribution and Return Rates

Item	Frequency	%
Questionnaires Distributed	380	100
Questionnaires Returned	369	97
Incomplete Questionnaires	16	3
Questionnaires captured for analysis	353	92

4. FINDINGS

4.1 Reliability and Validity of the Instrument

The overall Cronbach alpha coefficient for the instrument was .934 with all the 44 measurement items and larger than the threshold of .70 [17]. Meanwhile, the reliability analysis for each of the constructs was further assessed. Results have indicated that the Cronbach alpha coefficient of computer resources was .920 with 10 items, communication was .838 with 5 items, operation was .782 with 5 items, security was .882 with 6, technical support and expertise was .873 with 6, Data centers was .794 with 4, and E-government was .934 with 8. By implication therefore, all the constructs have Cronbach alpha coefficients above .70 which is considered the threshold for a reliable construct. Validity for the instrument was examined based on the Total Variance Extracted (TVE) per construct. As presented in Table 2, all the dimensions yielded TVE above 50%, which was an indicator of instrument validity.

Table 2. Reliability Statistics for each Component

Component	Cronbach's Alpha	Number of items	Construct Validity
			TVE (%)
Computer Resources	.920	10	58.3
Communication	.838	5	61
Operation	.782	5	53.7
Security	.882	6	63
Technical support and expertise	.873	6	61
Data centers	.794	4	62
E-government readiness	.898	8	59
Overall	.934	44	

Note: TVE (Total Variance Extracted)

Information on respondents' demographics was examined in terms of gender, range of age, education level, current job posting, working experience, and lastly experience with e-government. Table 3 gives the details pertaining to each of the demographic variables.

Table 3. Analysis of Respondents' Demographic Attributes (N=353)

Characteristic	Category	Frequency	%
Gender	Male	225	64
	Female	128	36
Age group	20-20 Years	92	26
	31-40 Years	141	40
	41-50 Years	76	22
	51 years and above	44	13
Education level	Bachelors	134	38
	Masters	143	41
	PhD	68	19
	Other	8	2
Current position	Employee	87	25
	Technical	75	21
	Teacher	69	20
	Engineering	60	17
	Manager	33	9
	Direct Manager	7	2
	Other	22	6
Years of Experience	1-5 Years	81	23
	6-10 Years	150	43
	11-15 Years	67	19
	16-years and above	55	16
Experience in e-government	Establishing	114	33
	Maintaining	87	25
	Researcher	89	25
	Others	61	17

As seen in Table 3, male participants in the study make up 64% (225/353) as compared to the females who trailed with 36% (128/353). Meanwhile, the respondents in the age range between 31 to 40 years are the majority constituting 40% (141/353), those in the age range 20 to 30 were about 26% (92/353) and participants in the age bracket of 41-50 were 22% (76/353). The respondents in the age range of 50 and above trailed with about 13% (44/353). In terms of education level, participants at the master's and bachelor's levels are the majority with 41% (143/353) and 38% (134/353) respectively. This was followed with PhD holders constituting about 19% (68/353), yet the least portion of respondents constituting just 2% (08/353) reported their education level as other. Additionally, respondents' current job postings were assessed and it was found the many reported themselves as being employees (25%), doing technical work (21%), teaching (20), and engineers (17%). This is followed by those who reported themselves as managers (11%), yet those doing other jobs are merely at 6%. With regard to the working experience in establishing/maintaining/researcher of e-government, 43% (150/353) of the respondents reported having worked for a period of six to ten years, followed by those who have worked for one to five years (23%). Meanwhile, those with working experience of 11-15 years and 16 years and above were 19% (67/353) and 16% (55/353) respectively. Lastly, working experience with e-government was examined. Results indicate that staff involved in establishing e-government was the majority with 33% (115/353), while those involved in maintaining and research were both at 25%. On the other hand, staff involved in the other e-government activities was just 61/353 (17%).

Principal component analysis (PCA) was employed in an effort examine the underlying factor structure of the technological factors and E-government readiness constructs' and find out if they constituted meaningful and interpretable dimensions. The data was run using SPSS software version 20.0, with special attention being paid to the inter-item correlations, internal consistency and the standardised factor loadings. Thus, the aim of Principal component analysis was to purify, refine and reduce the number of items and make them suitable for further multivariate analysis.

The 53 items measuring technological factors and E-government readiness were subjected to Principal component analysis (PCA). Moreover, Promax was applied as the rotation method since it was assumed that the expected components for technological factors and E-government readiness were theoretically correlated. Before conducting PCA, the extent of suitability of the quantitative data set for factor analysis had to be examined. To that end, a close assessment of the correlation matrix showed the presence of many coefficients above 0.3. In addition, Table 4 indicates that the Kaiser-Meyer Olkin measure of sampling adequacy (KMO) value was .916, which had exceeded the threshold of .60. The Bartlett's Test of Sphericity achieved statistical significance x2 (1378) =10938.052, p=.000, which indeed has supported the correlation matrix's factorability [17].

Table 4. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.916
Bartlett's Test of Sphericity	Approx. Chi-Square	10938.052
	df	1378
	Sig.	.000

As seen in Table 5, the initial PCA solution extracted 8 components with Eigenvalues greater than 1, which seemed to agree with the scree plot in Figure 1. The extracted components cumulatively had a Total Variance Explained of over 61%. Moreover, in the order of importance, the first component had a Total Variance Explained of 29.6%, and the least was 2.3% for the eight components.

Scree Plot

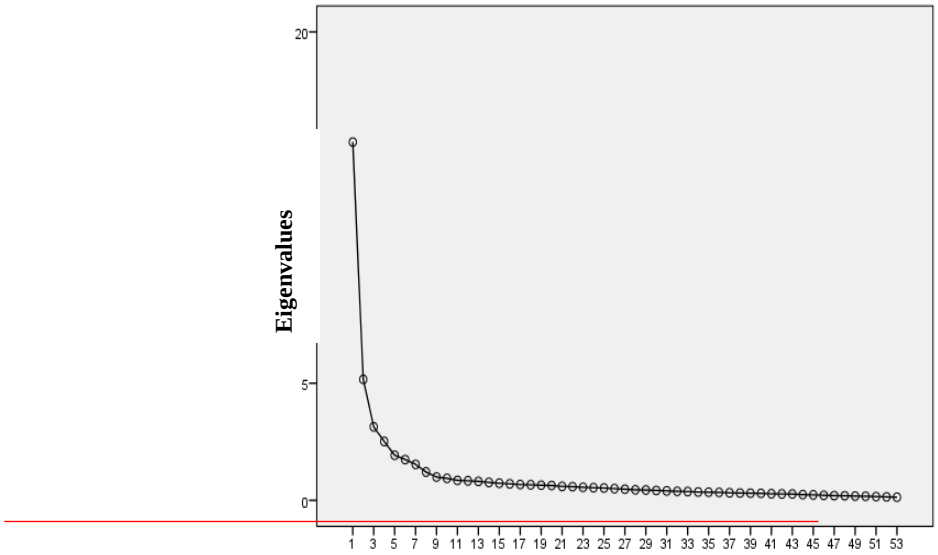

Figure 1. Screen Plot

Table 5. Initial Components Extracted Based on the Eigenvalues

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	14.806	29.613	29.613	14.806	29.613	29.613	10.867
2	4.715	9.431	39.044	4.715	9.431	39.044	9.935
3	2.729	5.458	44.502	2.729	5.458	44.502	10.107
4	2.504	5.008	49.510	2.504	5.008	49.510	8.506
5	1.858	3.716	53.226	1.858	3.716	53.226	4.322
6	1.725	3.450	56.677	1.725	3.450	56.677	3.779
7	1.309	2.619	59.296	1.309	2.619	59.296	6.471
8	1.152	2.304	61.600	1.152	2.304	61.600	7.466
9	.948	1.895	63.495				
10	.923	1.845	65.340				
11	.851	1.702	67.042				
12	.813	1.625	68.667				
13	.780	1.561	70.228				
14	.753	1.507	71.734				
15	.712	1.424	73.158				
16	.692	1.383	74.542				
17	.657	1.314	75.856				
18	.646	1.293	77.149				
19	.631	1.263	78.411				
20	.615	1.229	79.640				
21	.585	1.170	80.810				
22	.576	1.151	81.961				

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
23	.545	1.089	83.050				
24	.524	1.049	84.099				
25	.504	1.007	85.106				
26	.462	.924	86.031				
27	.434	.869	86.899				
28	.426	.852	87.751				
29	.415	.829	88.580				
30	.394	.788	89.368				
31	.379	.757	90.125				
32	.374	.749	90.874				
33	.357	.713	91.587				
34	.349	.699	92.286				
35	.335	.671	92.957				
36	.316	.632	93.589				
37	.312	.625	94.214				
38	.295	.591	94.805				
39	.282	.563	95.368				
40	.277	.554	95.923				
41	.271	.543	96.465				
42	.264	.528	96.994				
43	.250	.501	97.494				
44	.218	.435	97.929				
45	.209	.418	98.347				
46	.194	.389	98.736				
47	.175	.350	99.086				
48	.170	.340	99.426				
49	.154	.307	99.734				
50	.133	.266	100.000				

Note: Extraction Method: Principal Component Analysis.

After the initial factor extraction was accomplished, the standardised factor loadings for each component were examined to ensure that only items with loadings above 0.5 were retained to guarantee convergent validity for the research instrument [9]. Furthermore, items that were cross-loading were dropped one after another, and components with less than three items were equally disregarded to achieve a stable factor solution. Thus, a total of 3 items that cross-loaded were dropped, and these were data3, secur1, secur2 and secur9. Meanwhile, it was revealed that component 7 had only two valid items of egov9, egov10 left, and was therefore disregarded. Thus, implying that the final extracted solution now had 7 components with a total of 47 items satisfied the requirements were retained for inclusion in the final analysis.

Table 6. Factor Loading Pattern Matrix[a]

	Component							
	1	2	3	4	5	6	7	8
comc1				.678				
comc2				.786				
comc3				.871				
comc4				.685				
comc5				.638				
data1								.708
data2								.451
data3				.357				.394
data4								.694
data5								.638
comp1	.530							
comp2	.614							
comp3	.587							
comp4	.804							
comp5	.793							
comp6	.877							
comp7	.882							
comp8	.794							
comp9	.796							

	Component							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
comp10	.712							
egov1			.707					
egov2			.694					
egov3			.641					
egov4			.840					
egov5			.672					
egov6			.686					
egov7			.755					
egov8			.740					
egov9							.777	
egov10							.681	
secu1		.508					.356	
secu2		.625					.310	
secu3		.704						
secu4		.689						
secu5		.691						
secu6		.798						
secu7		.849						
secu8		.882						
secu9							.311	
oper1						.574		
oper2						.660		
oper3						.796		
oper4						.819		
oper5						.732		
tech1					.751			
tech2					.741			
tech3					.740			
tech4					.812			
tech5					.802			
tech6					.761			

Note: Extraction Method: Principal Component Analysis; Rotation Method: Promax with Kaiser Normalization; a. Rotation converged in 7 iterations.

Meanwhile, the 7 components that were retained having satisfied the requirements were named accordingly. In that case, component 1 was labelled Computer resources with 9 items. Security represented the second component with 9 items and E-gov't with 7 items represented the third component. Component 4 was named Communication with a total of 5 items; Component five was made up of 5 items and was labelled Technical Expertise, while Operation was attached to component six with a total of 5 items. Lastly, component 7 was named Data Center, made up of 4 items. The pattern matrix as in Table 6 gives the details of the components and the corresponding factor loadings.

Convergent and discriminant validity are essential ingredients of construct validity, because a measurement model can be used to test for causal relationship when it has evidence of sound construct validity and reliability. Convergent validity demonstrates the degree to which the observed variables of the latent constructs correlate with each other. On the other hand, discriminant validity measures the extent to which the observed variables have an association have association with their corresponding latent constructs. Upon successful assessment of the goodness-of-fit of the measurement model, convergent and discriminant validity for the predictor and outcome variables was estimated to establish how distinct they were. As summarised in Table 7, the Composite Reliability (CR) of each latent construct for the measurement model should be equal to or greater than 0.7 to satisfy reliability; while the Average Variance Extracted (AVE) should be above 0.5 but greater than the squared inter-factor correlations so as to meet the requirements for convergent and discriminant validity [12, 9].

Table 7. The Threshold for Assessment of Construct Validity and Reliability

Assessment	Threshold
Convergent validity	Standardised factor loadings > 0.5
	Composite reliability > 0.7
	Average Variance Explained (AVE) > 0.5
Discriminant validity	AVE > Squared inter-correlation values
	Inter-correlation values < 0.8

The Convergent validity in the measurement model was evaluated using the factor loadings, the critical ratios and composite reliability. According to Table 8, all the factor loadings were well above 0.50 which gave evidence of

convergent validity [3]. In addition, the critical ratios (CR) are greater than 1.96, with the corresponding *p*-values less than 0.001 the measurement items; which indicated their statistical significance. Moreover, according to Table 8, the Average Variance Explained (AVE) and the composite reliability met the threshold of 0.50 and 0.70 respectively [9, 10]. To that end, evidence of convergent validity in the measurement model has been established.

Table 8. Regression weights: (Group number 1 - Default model)

Construct	Estimate	S.E	C.R	P-value	Composite Reliability	AVE
Computer Resources					**.919**	**.54**
comp10	1.053	0.07	15.126	***		
comp9	0.962	0.063	15.266	***		
comp8	0.947	0.064	14.704	***		
comp7	1					
comp6	0.966	0.061	15.903	***		
comp5	1.011	0.064	15.891	***		
comp4	1.099	0.069	15.876	***		
comp3	0.843	0.067	12.552	***		
comp2	0.913	0.071	12.901	***		
comp1	0.831	0.068	12.266	***		
Operation					**.786**	**.53**
oper1	1					
oper2	1.034	0.13	7.973	***		
oper3	1.296	0.14	9.27	***		
oper4	1.425	0.147	9.668	***		
oper5	0.986	0.122	8.063	***		
Security					**.881**	**.57**
secu8	1					
secu7	0.951	0.071	13.332	***		
secu6	0.965	0.074	13.043	***		
secu5	1.113	0.079	14.097	***		
secu4	1.061	0.079	13.407	***		
secu3	0.884	0.069	12.796	***		
Technical Expertise					**.851**	**.61**
tech6	1.015	0.083	12.288	***		
tech5	1.06	0.087	12.225	***		
tech4	1.085	0.084	12.845	***		
tech3	1					
tech2	1.019	0.081	12.573	***		
tech1	1.004	0.084	11.935	***		
Data Center					**.794**	
data5	1.236	0.103	11.97	***		
data4	1.214	0.102	11.913	***		
data2	1					
data1	0.954	0.096	9.974	***		
Communication					**.782**	**.55**
comc5	1					
comc4	1.1	0.099	11.128	***		
comc3	1.289	0.104	12.456	***		
comc2	1.124	0.093	12.097	***		
comc1	1.08	0.102	10.541	***		

Note: SE (Standard Error), CR (Critical Ratio)

As summarised in Table 9, evidence of discriminant validity has been achieved. That is, the Average Variance Explained for the respective technological factors are presented along the diagonal, with all of them above 0.5. Above the diagonal are the squared inter-factor correlations, with none of them exceeding the calculated Average Variance Explained, apart from the isolated case of the squared shared variance for data center and security of 0.587 [3]. The inter-factor correlations (shared

variance) values for all the technological factors are presented below the diagonal and all of them are below 0.8 [13]. Thus, the standards for discriminant validity of the measurement model have been met.

Table 9. AVE and Shared Variance values for the initial measurement model

Dimension	1	2	3	4	5	6
comp	**0.54**	0.28	0.424	0.349	0.011	0.018
datactr	0.651	**0.6**	0.587	0.246	0.001	0.003
securi	0.591	0.514	**0.57**	0.358	0.012	0.007
tecex	0.107	0.038	0.598	**0.61**	0.025	0.275
oper	0.135	0.051	0.109	0.159	**0.53**	0.001
comc	0.529	0.766	0.082	0.524	-0.027	**0.55**

5. DISCUSSION

The revolution of information technology (IT) has stimulated transformational economic and social moves worldwide. The IT has shortened distance and time and opened up unprecedented opportunities leading to moves in political and power structures of economic. New technologies have a continuous sound effect on the political, economic, social and cultural world values in the near future [7]. The ICT is a main motivation to deliver the government services to citizens and businesses in the information age. Governments, thus aim to improve public services delivery by using ICT [14]. It can be concluded that in the information age all images of the brave new world were made possible through e-government. So, in this age all of the countries need to implement this innovative service to serve public. It is notable that the counties and all nations have considered that e-government is an essential component of human development. Therefore, the current study explores the underlying technological factors and e-government readiness constructs among the technical staff at ministry of communications and informatics in Benghazi city and Tripoli city in Libya. The result obtained from the data analysis in this study yielded eight underlying technological factors and e-government readiness constructs among the technical staff at ministry of communications and informatics in Benghazi city and Tripoli city in Libya. The factors extracted are: Computer resources i.e. software and hardware, Data centres, security, technological expert support, operational, Communication and e-government readiness. The reliability test was confirmed and that the measures were internally consistent, as all of the constructs possessed a Cronbach's alpha above (0.70). The construct validity was established utilizing the PCA. A significant probability tests resulted. The components consistent with the number of independent factors in the conceptual model resulted that Eigenvalues above (1), and factors validity were loaded and resulted in all items having a score of at least (0.40). In addition, the results revealed that there was no cross loading above (0.40), and this confirmed that both types of the construct validity existed in the survey instrument.

6. CONCLUSION AND RECOMMENDATIONS

The practical contribution of the study to the field of e-government readiness constructs among the technical staff at ministry of communications and informatics in Benghazi city and Tripoli city in Libya is the evidence it provides in support of the component 1 was labelled Computer resources with 9 items. Security represented the second component with 9 items and E-gov't with 7 items represented the third component. Component 4 was named Communication with a total of 5 items; Component five was made up of 5 items and was labelled Technical Expertise, while Operation was attached to component six with a total of 5 items. Lastly, component 7 was named Data Center, made up of 4 items measuring e-government readiness constructs among the technical staff at ministry of communications and informatics in Benghazi city and Tripoli. Confirmatory Factor analysis was employed as a tool to evaluate the psychometric properties of the technological and E-government Readiness constructs in terms of validity and reliability. All the dimensions were valid and reliable. The study shows that it is not only a reliable instrument for assessing e-government readiness, but also an important construct to be born in mind by technical staff at ministry of communications and informatics, practitioners and those responsible for government sectors, as well as decision makers seeking to promote e-government. The multidimensional constructs show potential for future research in the field of technology.

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Compliance with Ethical Standards

Conflict of Interest

The authors declare that they have no conflict of interest.

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