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The Moderating Effect of IT Knowledge on the relationship between Organizational Factors and Information Systems Interoperability Level among Jordanian Ministries

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ABSTRACT

Background: Information systems (IS) interoperability considered from the main characteristic of successful e-Government projects in the past twenty years. As information systems and technologies are being developed and improved, debates on their success have been constantly discussed by researchers and scholars. Achieving interoperability among different organizations is a complex task and affected by various aspects. One of these aspects is the organizational factor. **Objective**: This study examines the organizational factors that impact IS interoperability level focusing on IS Interoperability as the key concept to reach successful implementation of interoperability in public sector. **Methodology**: In order to explore the study constructs and their relationships a variety of published literatures concerning the scope of the study has been critically reviewed. Moreover, data was gathered using survey through distributing 355 questionnaires to the employees of IT departments in 25 Jordanian ministries. 231 usable questionnaires were returned. The data was analyzed through the technique of Partial least squares-structural equation modeling (PLS-SEM). **Results**: The findings revealed that the organizational factors (BPM, HRS, ROI, and RIM) positively affect IS interoperability level. On contrary, there was no moderating effect of the IT knowledge in the relationship between organizational factors and IS interoperability level. **Conclusion**: organizational factors are good for enhancing ISIL, which implies that government entities must reinforce these four critical dimensions of organizational factors (BPM, HRS, ROI, and RIM). On contrary, there was no moderating effect of IT knowledge between organizational factors and IS interoperability level among ministries in Jordan.

INTRODUCTION

Interoperability defined as the ability of various types of systems to work together in order to exchange information effectively in a meaningful manner (Lallana, 2008). It is widely agreed that establishment of interoperability between information systems (IS) of an organization with one or more cooperating organizations can enhance delivering service or business value. Moreover, according to Loukis and Charalabidis (2013) IS interoperability has a great possibility to enhance the performance of the organizations' business process to assist deeper cooperation between organizations and to gain value creation through innovation.

IS interoperability played a great role in public sector and considered as the key concept for government delivering services (Pardo and Burke, 2008). Moreover, Staden and Mbale (2012) emphasized that in order to

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reach electronic government (e-Government) aims; there is a necessity to connect government to its stakeholders both internally and externally. However, part of government interoperability organizational interoperability considered to be a sustainable success factor for e-Government projects (Kubicek and Cimander, 2009). Saekow and Boonmee (2010) defined organizational interoperability as the coordination of business processes between different organizations to facilitate their work and achieve their mutually agreed goals.

There are many obstacles that can influence the interoperability of information systems in the government sector as well as in the private sector, these barriers classified as economic, political, organizational, and technical issues which could prevent government and business from implementation successful e-service projects (Al-Shboul *et al*., 2014; Sulehat and Taib, 2016). According to Heeks (2003), almost 35% of e-Government projects have totally failed in developing countries, 50% has partially failed, and just 15% cases of implementing e-Government in developing countries were successful. Pudjianto and Hangjung (2009) also mentioned that approximately 60% of the e-Government implementation projects could not reach the expected outcomes or fail. Moreover, according to United Nations (2016, 2014, 2012, 2010, 2008, and 2005), a survey of 193 country over the world was held by the United Nations Department of Economic and Social Affairs (UNDESA) since 2001 shows that the rank of Jordan in e-government development index (EGDI) in 2016 retreat to position 91 compared with 50 in 2008.

In this study, the researchers focus on the government ministries in Jordan that mainly considered as the backbone of the public sector. In the context of Jordan, although Jordanian ministries contribute significantly to the socio – economic development and enhance the quality of citizens' life of the Kingdome, the internal information systems interoperability still faces challenges. Jordanian government has acknowledged the importance of IS interoperability in developing the country's ICT sector. The aim of this paper is to analyze the information systems interoperability and indicate the most critical factors that are related to the organizational interoperability through systematic empirical investigation of ICT among Jordanian ministries.

Literature Review:

The aim of this section is to give an overview of the three dimensions of research model information systems interoperability, organizational factors, and the moderating effect of the IT knowledge. Moreover, highlights on the previous works on the mentioned areas.

Information Systems Interoperability:

Interoperability is the key success for the effective evolution of cooperation and partnership of different organizations (Clark and Jones, 1999). It is about the features of hardware and information systems to communicate, connect, and work accurately to maintain the resulting interconnection and enhance the integration (Knight *et al*., 2013). Moreover, Staden and Mbale (2012) asserted that to establish feasible e-Government projects; the related stakeholders' systems should be connected in a way that information systems are interoperable. Thus, interoperability is considered as the main success key of information sharing and data exchange among heterogeneous and different systems. Sulehat and Taib (2016) stated that before starting comprehensive e-Government initiatives, government needs to realize its current level, the desired level of interoperability, and the gap between them.

Most researchers focused on the interoperability maturity models that have been developed such as: Organizational Interoperability Maturity Model (OIM), Capability Maturity Model (CMMI), Government Interoperability Model Matrix (GIMM), Levels of Conceptual Interoperability Model (LCIM), and Maturity Model for Enterprise Interoperability (MMEI). According to Staden and Mable (2012) the interoperability models (i.e., OIM, CMMI, GIMM, LCIM, and MMEI) define a very similar interoperability maturity levels with the main differences between these models, their focus and the way in which they rate interoperability. The mentioned models are partially dealing with some parts of interoperability.

Organizational Factors:

Organizational interoperability defined as the coordination and collaboration of business processes among different organizations to ease and enhance their work to achieve their mutually common goals (Saekow and Boonmee, 2010). The most organizational factors that affect IS interoperability can be summarized as follows:

- ***Top Management Support (TMS):***

Considered as one of the main forces that affect IS interoperability, this driving force identifies the clear strategy, clear responsibility, accountability, motivations, and full awareness for any e-Government project (Ali and Sunitha, 2007; Ragu-Nathan *et al*., 2004).

- ***Business Process Management (BPM):***

Management of services that can be carried out from different operational procedures through enabling a cross-agency services, which means each process pass through various governmental channels in order to enhance and facilitate the process for IS interoperability (Paul and Paul, 2012).

- ***Human Resources (HRS):***

Lack of ICT skills in the government sector is considered a big challenge for IS interoperability, mainly in developing countries there is a lack of qualified well-trained HR in the ICT filed (Hellman, 2010).

- ***Collaboration and Coordination (COC):***

Working across governmental agencies is facilitated through focusing on shared vision and collaboration between various entities through coordination in order to achieve common goals (Al-Sobhi and Weerakkody, 2010).

- ***Return on investment (ROI):***

Cost and benefits analysis must be done periodically to ensure the net benefits from different stakeholders, effective benefits can be gained through private public partnership (PPP) to enhance responsiveness, reduce costs, and minimize resistance to change (Sohimi and Abbas, 2011).

- ***Risk Management (RIM):***

Defined as formal continuous process performed during the entire life cycle of a project (Merna and Al-Thani, 2011). Thus, avoid failure of the project is considered a priority in the risk management plan and should be done during the analysis phase. Risk mitigation activities can be performed during the project phases, the identification of the risk in the earlier stages; the easier to mitigate activities (De Angelis, 2009)**.**

Organizational Factors and Information Systems Interoperability Level:

A review of literature in the field of interoperability has shown that organizational factors have significant influence on the IS interoperability, these factors such as TMS and COC affect in a positive way IS interoperability level (Sohimi and Abbas, 2011; Knight *et al*., 2013). On the other hand lack of IT HRS skills and poor BPM can decrease IS interoperability level (Ebrahim and Irani, 2005; Sulehat and Taib, 2016). Other factors such as ROI and RIM can affect the IS interoperability level according to the initial and running costs (Al-Sobhi and Weerakkody, 2010; De Angelis, 2009). In the view of the above explanations, it is hypothesized that:

H1: There is positive relationship between organizational factors and IS interoperability.
H1a: There is positive relationship between top management support and IS interoperability.
H1b: There is positive relationship between business process management and IS interoperability.
H1c: There is positive relationship between human resources and IS interoperability.
H1d: There is positive relationship between collaboration and coordination and IS interoperability.
H1e: There is positive relationship between return on investment and IS interoperability.
H1f: There is positive relationship between risk management and IS interoperability.

The Moderating Effect of IT Knowledge:

Knowledge is a combination of data, information, facts, experience, skills, and interpretation which is difficult to be measured (Davenport, 1998). Moreover, it is the capability to use information for problem solving and plays a great role in interoperability through transfer knowledge among various environments which is described as interoperability knowledge (Berankova *et al*., 2010). IT knowledge defined as a combination or set of techniques and principles that are useful to focus the resources of the organization towards the desired objectives (Ringim *et al*., 2012). According to Bassellier *et al*. (2001), knowledge classified into two types tacit and explicit knowledge that are used to solve problems to achieve the goals of the organization, which are defined as follows:

Tacit knowledge:

This type of knowledge acquired through experience and improves memory about the mechanism of a particular action, which leads to enhance the levels of competency (Ringim *et al*., 2012). The diversity and density of the experiences affect significantly the tacit knowledge level. According to Bassellier *et al*. (2001) and Smith (2001), knowledge is gained through internalized learning, which begins as explicit knowledge and then converts into tacit knowledge.

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Explicit knowledge:

This type of knowledge obtained through reading, learning discussion, and explanation (Ringim *et al*., 2012). The expertise that are related to technology and communication skills which facilitate access to other sources of IT knowledge considered as an important component of explicit knowledge (Sanchez, 2004).

Therefore, it is hypothesized that

H2: IT knowledge moderates the relationship between organizational factors and the IS interoperability.

H2a: IT knowledge moderates the relationship between top management support and IS interoperability.

H2b: IT knowledge moderates the relationship between business process management and IS interoperability.

H2c: IT knowledge moderates the relationship between human resources and IS interoperability.

H2d: IT knowledge moderates the relationship between collaboration and coordination and IS interoperability.

H2e: IT knowledge moderates the relationship between return on investment and IS interoperability.

H2f: IT knowledge moderates the relationship between risk management and IS interoperability.

Conceptual Framework:

Organizational factors and IT knowledge appear to be major interests in order to enhance IS interoperability level in organizations. Therefore, based on the previous discussion the proposed conceptual framework is shown in Figure 1.

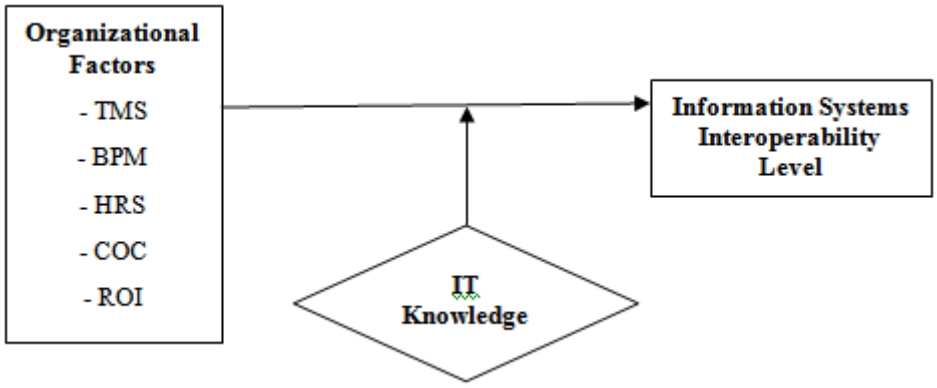

Fig. 1: Conceptual Framework

Research Methodology and Analysis:

This part presents the main methodology that used to support the process of fulfilling this paper objective. Firstly, brief of the respondents of the study were introduced; secondly, the tools that were used to measure the conceptual framework and that were used for data analysis were also summarized; finally, the study model evaluation for both the measurements model and the structural model were presented.

Respondents of the Study:

In this study, data was collected from IT departments that are distributed in 25 ministries during the period from Dec. 2016 until Feb., 2017 which covers all the ministries in the capital of Jordan. The distributed questionnaires were 335; and 244 questionnaires were returned. Consequently, the response rate of the returned questionnaire is 73%; however, out of the 244 responses that were obtained, only 231 questionnaires were used for further analysis making a valid response rate of 69% (Yehuda, 1999). According to Babbie (1990), in the social sciences studies, 50% is considered an accepted response rate, while at least 60% classified as good response rate, and a response rate of 70% or more categorized as is very good. The analysis showed that there is high number of employees holding bachelor degree with 76.2% followed by master 14.3%, diploma 7.8%, while 1.7% represents the employees with high school degree, in contrast none of the respondents holding PhD degree. Other findings of this study showed that most of the respondents were employees without any supervision positions with 68.8%, while only 22.1% and 7.8% for head of division and head of department respectively; moreover, just 1.3% represents temporary contracts or working through specified project. Furthermore, the results exposed almost equal percentage of 24.2 and 26 respondents with experience between 6 to 10 and 11 to 15 respectively. The highest percent of respondents with 33.8 have an experience for more than 15 years while just 16% employee worked up to 5 years. The results also showed that most of the respondents in the middle age with 58% and 26% between 41 and 50, while the lowest percentage was very closed 7.4% and 8.7% for the employees age under 30 and over 50 respectively. The last finding related to demographic factors

showed high percentage of males representing 60.6% and just 39.4% females working in ministries' IT departments despite of an equal percentage between males and females in Jordan.

Measurements:

All measures used a five-point Likert scale, thus 1 represents "strongly disagree", 2 represents "disagree", 3 represents "neutral", 4 represents "agree", and 5 represents "strongly agree" (Likert, 1932). Firstly, organizational factor was measured using by six dimensions, TMS, BPM, HRS, COC, ROI, and RIM. Organizational factor was measured by 23 items, TMS and BPM were measured by five questions for each item scale while HRS was measured using by four questions, COC was measured by three questions, ROI was measured by two questions, and RIM was measured by four questions. Secondly, the moderator IT knowledge was measured by four questions. Finally, IS interoperability was measured by seven questions.

Data Analysis:

Nominal data analysis was performed using IBM SPSS 22 Statistics tools while partial least squares (PLS) path modeling using Smart PLS 3.0 software was used for ordinal data analysis (Sarstedt *et al*., 2014; Henseler *et al*., 2009; Wold, 1975). To test the hypotheses, analyze of both the measurement model (outer model) and structural model (inner model) were performed (Lowry and Gaskin, 2014; Sarstedt *et al*., 2014).

Measurement Model:

Assessment of measurement model is considered as the major step in PLS-SEM analysis (Hair *et al*., 2013). Specifically, measurement model analysis assures the reliability and validity of the constructs. According to Henseler *et al*. (2009), the outer model can be evaluated through the values of average variance extracted (AVE), composite reliability (CR), discriminant validity, and convergent validity. Furthermore, outer loadings and cross loadings were used to evaluate the indicator reliability. Therefore, in this study, internal consistency reliability was assessed by examining CR.

According to Hair *et al*. (2013), CR does not require an equal indicator loading of construct unlike Cronbach's alpha and CR values located between 0.6 and 0.7 were accepted however values located among 0.7 and 0.9 were count as more eligible (Henseler *et al*., 2009; Nunnally and Bernstein, 1994). The Cronbach's alpha values range among 0.75 to 0.90 and CR values located within 0.85 to 0.95 for all constructs as shown in Table 1 and figure 2, these results are in line with Hair *et al*. (2013) and Henseler *et al*. *(*2009) recommendations.

Table 1: Construct Reliability and Validity

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
TMS	.88	.91	.67
BPM	.85	.89	.62
HRS	.85	.90	.69
COC	.82	.89	.73
ROI	.85	.93	.87
RIM	.85	.91	.77
ITK	.74	.84	.57
ISIL	.88	.90	.57

Note: TMS=Top Management Support, BPM= Business Process Management,
HRS=Human Resources, COC= Collaboration and Coordination, ROI= Return On Investment,
RIM=Risk Management, ITK=IT Knowledge, ISIL= Information Systems Interoperability Level.

According to Sarstedt *et al*. (2014), convergent validity is the degree of agreement between multiple constructs that are used to measure specific concept. Furthermore, AVE is accepted with starting value of 0.50 and over (Henseler *et al*., 2009). In this study, convergent validity was measured by checking AVE values. Table 1 showed that all constructs' AVE exceeds the accepted value of 0.50. As a result the convergent validity is established because the AVE values fitted within 0.52 and 0.87.

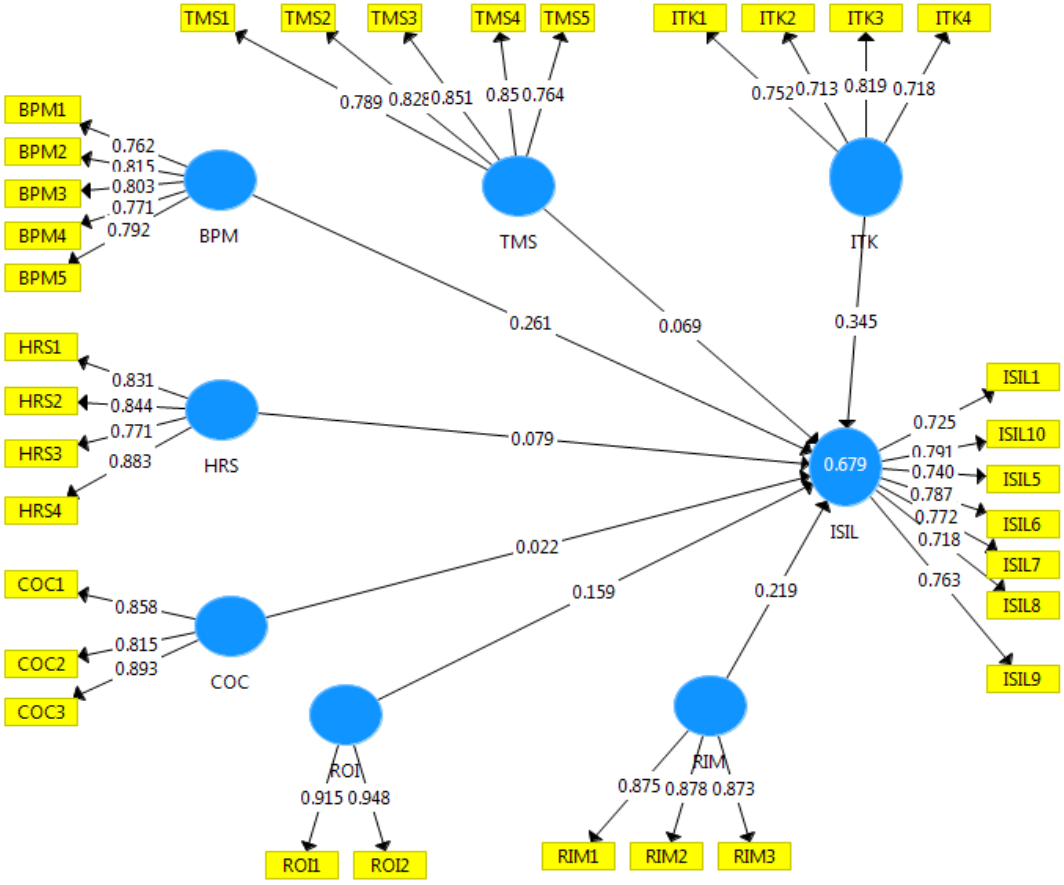

Fig. 2: Measurement Model

The next step was to examine the discriminant validity, based on Hair and Hult (2016), the discriminant validity requires that each latent constructs' AVE should be higher than the construct's highest squared correlation with other latent construct and the indicators loadings should be more than all its cross loadings. In this study, discriminant validity was examined through the Fornell and Larcker's (1981) criterion as shown in Table 2.

Table 2: Discriminant Validity

Construct	BPM	COC	HRS	ITK	RIM	ROI	TMS	ISIL
BPM	.79							
COC	.32	.86						
HRS	.48	.18	.83					
ITK	.60	.37	.42	.75				
RIM	.29	.32	.31	.33	.88			
ROI	.37	.19	.20	.35	.03	.93		
TMS	.70	.32	.49	.53	.31	.33	.82	
ISIL	.68	.37	.49	.71	.47	.43	.60	.76

Structural Model:

Assessment of the structural model was performed after evaluation of the outer model which is prerequisite for this analysis. According to Chin (1998), Hair and Hult (2016) recommendations, an assessment of the inner model direct relationship among exogenous and endogenous constructs was performed via the value of standard error, path coefficient, p-values, and t-values. Bootstrapping procedure in Smart PLS 3.0 software (Ringle *et al*., 2014) was performed to test both the direct and moderating effect models.

Direct Relationships:

Based on the PLS testing, Table 3 shows the results of the direct relationship hypothesis of the organizational factors as the proposed below main hypothesis:

H1: There is positive relationship between organizational factors and IS interoperability.

The result shows that four of the exogenous variables have a positive coefficient with the endogenous variable while two exogenous constructs have a negative coefficient with the endogenous construct. According to H1a hypothesis, there is no positive impact of TMS on ISIL (β.069; t=1.280; p>.1); thus, H1a is not supported. While, H1b is supported as the result reveal there is a positive influence of BPM on ISIL (β.260; t=4.364; p<.01). However H1c, shows a positive impact of HRS on ISIL (β.079; t=1.904; p<.1); consequently H1c is supported. On the contrary H1d, shows no positive impact of COC on ISIL (β.022; t=.500; p>.1); so, H1d is not supported. Meanwhile, both hypotheses H1e and H1f are supported as the results show positive impact of ROI and RIM on ISIL (β.159; t=3.666; p<.01) and (β.219; t=4.131; p<.01) respectively. Thus, H1 is partially supported.

Table 3: Results of Hypotheses Testing for Organizational Factors (Direct Relationships)

Hypotheses/Path		Path Coefficient	Standard Deviation	T Statistics	P Values	Decision
H1a	TMS -> ISIL	.069	.054	1.280	.201	Not supported
H1b	BPM -> ISIL	.261***	.060	4.364	.000	Supported
H1c	HRS -> ISIL	.079*	.041	1.904	.057	Supported
H1d	COC -> ISIL	.022	.044	.500	.617	Not supported
H1e	ROI -> ISIL	.159***	.043	3.666	.000	Supported
H1f	RIM -> ISIL	.219***	.053	4.131	.000	Supported

*:p<0.l; **:p<0.05; ***:p<0.0l

Moderation test:

The interacting effects of IT knowledge on the relationship between organizational factors: TMS, BPM, HRS, COC, ROI, RIM and the endogenous construct ISIL were examined and reported. Table 4 shows the results of indirect relationship among organizational factors and ISIL via the interaction of the moderator IT knowledge as the main hypothesis proposed below:

H2: IT knowledge moderates the relationship between organizational factors and the IS interoperability.

Table 4: Results of Hypotheses Testing for Organizational Factors (Indirect Relationships)

Hypotheses/Path		Path Coefficient	St. Deviation	T Statistics	P Values	Decision
H5a	TMS * ITK -> ISIL	.061	.090	.675	.500	Not supported
H5b	BPM * ITK -> ISIL	.085	.089	.952	.342	Not supported
H5c	HRS * ITK -> ISIL	.049	.092	.537	.592	Not supported
H5d	COC * ITK -> ISIL	.049	.050	.971	.332	Not supported
H5e	ROI * ITK -> ISIL	.000	.068	.004	.997	Not supported
H5f	RIM * ITK -> ISIL	.065	.100	.650	.516	Not supported

*:p<0.l; **:p<0.05; ***:p<0.0l

The hypothesis H5a is not supported; thus TMS*IT knowledge is not significant (β.061; t=.675; p>.1). Similarly, there is no positive effect of the BPM*IT knowledge (β.085; t=.952; p>.1); subsequently, H5b is not supported. Furthermore, H5c is not supported; as there is no positive impact of the HRS*IT knowledge interaction (β.049; t=.537; p>.1). Furthermore, the result shows no positive effect of the COC*IT knowledge (β.049; t=.971; p>.1); so, H5d is not supported. In the same way both hypotheses H5e and H5f are not supported; because there are no positive effect of ROI*ITK and RIM*ITK (β.000; t=.004; p>.1) and (β.065; t=.650; p>.1) respectively. Consequently, H2 is not supported.

RESULTS AND DISCUSSION

IS Interoperability considered from the main critical issues that face heterogeneous systems due to the need to access information from various information systems. The organizational factors considered from the main factors that lead to the success of IS interoperability within different institutions. The findings of this study reinforce prior studies, except the finding related to TMS and COC. The findings are not hypothesized regarding to TMS and COC. Hence, there is no significant relationship of TMS and COC on ISIL. Unexpectedly, from the current findings the TMS is not a factor that could influence ISIL; this finding is not consistent with previous studies which have found relationship between TMS and ISIL (Al-Mamary *et al*., 2014; Bajwa and Rai, 1994; Kamal *et al*., 2009; Khanh *et al*., 2014; Ragu-Nathan *et al*., 2004; Sohimi and Abbas, 2011). The logical reason for this is due to job dissatisfaction of the IT employees in the government comparing with the private sector.

Another finding of this study showed that there is no significant relation between COC and ISIL. This finding is slightly not consistent with previous studies which found relationship between COC and ISIL (Goldkuhl, 2008; Guedria, 2012; Kubicek, 2008; Kubicek and Cimander, 2009; Tarabanis, 2006; Ndou, 2004). However, the explanation of this inconsistent finding might be sensible due to the gap of the organizations'

sharing of its goals among employees and the closure of institutions on themselves regarding to sharing information. Due to the obvious lack in Jordanian ministries' internal environment, especially in group work, as well as Jordanian ministries continue to suffer from the limited budget dedicated for joint workshops and training programs.

On the contrary, the result from this study revealed that BPM, HRS, ROI, and RIM were positively influence ISIL. This finding supports prior related studies conducted by Paul and Paul (2012), Hellman (2010), Kamal *et al*. (2009), and De Angelis (2009). BPM is the important factor to facilitate business to improve ISIL. Moreover, RIM also considered from the important factors that has effect on ISIL. Further, ROI was an important predictor to ISIL. Lastly, the findings showed that HRS has limited influence on ISIL at the level of $p<.1$.

Unexpectedly, as the findings showed that H2 is totally rejected. IT Knowledge did not significantly moderate the relationship among organizational factors and ISIL. However, this inconsistency is reasonable due to Jordanian ministries still suffering in the culture of IT knowledge sharing. Theoretically, from the literature review it showed that there is lack of studies that testing IT knowledge as a moderator to ISIL. If there were studies examining IT knowledge as a moderator, it was related to organization performance only (Liu *et al*., 2008; Mazidi *et al*., 2014; Ringim *et al*., 2012; Wunnava and Ellis, 2009). Another finding of this study related to ISIL showed that 32% of the ministries have medium interoperability level between their information systems, and 60% of the ministries located in the lower level of interoperability while just 8% situated in the upper level of information systems interoperability.

Conclusion:

In conclusion, organizational factors are good for enhancing ISIL, which implies that Jordanian ministries must work hard to enhance these organizational dimensions. This study, explores empirically the moderating effect of IT knowledge in relationship between organizational factors and ISIL among Jordanian ministries. From the findings it concluded that dimensions of organizational factors (BPM, HRS, ROI, and RIM) were found significantly affect to ISIL in a positive way. Unexpectedly, the findings showed that there is no relationship between the two factors TMS and COC on ISIL. Moreover, the present study did not support the moderating effect of IT Knowledge between organizational factors and ISIL. Therefore, the interaction between public sector institutions needs more focusing on interoperate their information systems to enhance their ISIL among them and this could be done through transferring the organizational factors that were discussed previously from barriers to success factors. Moreover, Jordan has the infrastructure to enhance their IS interoperability between ministries but there still many forces prevent information systems from full interoperability within government entities these forces should be eliminated through vision convergence between government institutions.

The limitations of this study could open further studies. In later studies in this area, technical and semantic factors could be investigated to measure their effect on the e-Government interoperability. The present study can make an actual contribution to realize the real direction in the planning of interoperability among public organizations. Moreover, the present study also would benefit both practitioners and scholars in the ways for enhancing the level of interoperability in the public sector. A literature search exposes limited empirical studies on the issues of interoperability among public sector in Jordan.

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