ISSN 2228-9860 eISSN 1906-9642 CODEN: ITJEA8

International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

The Relationship between Information and Communications Technology Infrastructure and Adoption of Enterprise Resource Planning in SMEs in Saudi Arabia

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Paper ID: 13A10H

Volume 13 Issue 10

Received 25 April 2022
Received in revised form 01 July 2022
Accepted 08 July 2022
Available online 15 July 2022

Keywords:
Business; Finance; Human resources; Software system; Productivity; Routinization; Information Technology

Abstract

The implementation of ERP significantly contributes to SMEs in terms of cost savings, improved operational efficiencies, and effective customer service, leading to considerable productivity growth. Enterprise Resource Planning plays a significant role in providing different potential advantages. However, the implementation of ERP among SMEs in developing countries is limited. Comparatively, few SMEs in Saudi Arabia use ERP solutions to tap their vast potential. ICT infrastructure issues can have an impact on the implementation of ERP systems. This paper aims to investigate the relationship between information and communications technology (ICT) infrastructure and enterprise resource planning (ERP) implementation in small and medium enterprises (SMEs) in Saudi Arabia. The quantitative method was used to collect the data via a self-administered questionnaire. The findings of this study demonstrated that ICT infrastructure does not have a significant relationship with ERP adoption and evaluation. However, a significant relationship was found between the ICT infrastructure and ERP routinization. Accordingly, enhancing technology awareness by providing adequate training and technical support for implementing ERP is highly recommended.

Discipline: Business Management (SME).

Cite This Article:

Alzughaibi, S., Saad, N. H., and Mahmud, I. (2022). The Relationship between Information and Communications Technology Infrastructure and Adoption of Enterprise Resource Planning in SMEs in Saudi Arabia. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 13*(10), 13A10H, 1-12. http://TUENGR.COM/V13/13A10H.pdf DOI: 10.14456/ITJEMAST.2022.197

1 Introduction

Today's dynamic business environment has driven small and medium enterprises (SMEs), as well as large enterprises (LEs), towards a significant shift in their traditional business models to achieve the goals of the firm's survival and competitive advantage (Heredia-Calzado & Duréndez, 2019). In this context, the Enterprise Resource Planning (ERP) systems provide effective business alternatives and directions, which enable firms to change the way they handle, manage the skills of their employees, and integrate solutions for the company's information processing in all aspects of business in an integrated real-time environment (Asmussen & Møller, 2020). ERP systems are computerized management systems. These systems allow data storage and processing to facilitate its exchange between different departments. They contribute to creating efficient management of administrative processes (Heredia-Calzado & Duréndez, 2019). In this sense, ERP systems are tools designed to rationalize by integrating an operational solution for business functions, such as manufacturing, finance, human resources, marketing, and supply chain management in a single system (Konthong et al., 2016). Organizations invest in ERP systems to facilitate the flow of information between different departments, from firm to suppliers/customers - into an integrated system with shared data and visibility. Therefore, research regarding the role and value of ERP is critical to the implementation of ERP in achieving an ongoing competitive advantage for the firm. This paper investigates the relationship between information and communications technology (ICT) infrastructure and enterprise resource planning (ERP) implementation in small and medium enterprises (SMEs) in Saudi Arabia.

2 Literature Review

2.1 Small and Medium Enterprises (SMEs) in Saudi Arabia

Saudi Arabia is a resource-rich country with about one-fifth of the world's oil reserves. It is an economic giant in the Gulf region, amounting to 25% of the world's established oil reserves, with many involved primarily in producing energy and oil (Almoawi & Mahmood, 2011). Moreover, Saudi Arabia is one of the largest twenty economies in the world and the largest economy in the Middle East, producing about 25% of the total Arab gross domestic product (GDP) (Al-Bar & Hoque, 2019a). With this achievement and drive to become a world oil market, the Saudi government has considered developing local businesses, such as SMEs.

While various criteria are used to define SMEs in the context of the Gulf countries, the definition of SMEs in Saudi Arabia is based on the number of employees. Chaudhry (2011) also argues that due to the scarcity of financial data in the Gulf, most public and private organizations often base their definition of SMEs solely on the number of employees. For example, Berisha-Namani (2009) provides a widely accepted definition in Saudi Arabia: *"small-sized enterprises have between 1 and 49 employees, while medium-sized enterprises are firms that have between 50 and 100 employees."* Recently, the Ministry of Commercial and Investment has defined SMEs based on the

number of employees in a particular business as small enterprises are firms that include 6 to 49 employees, whereas medium-sized enterprises are firms with 50 and 249 employees.

Globally, SMEs play a vital role within all economies due to their growing importance in income generation, labour absorption, poverty alleviation, and contribution to GDP (Hunt, 2017). SMEs account for over 95% of firms and 60% of employment and represent a large share of job opportunities, the highest sales, innovation activities, and employment growth (Choi & Lim, 2017). The SME sector plays an essential role in the economy and could potentially enable the Saudi government to reduce its primary dependence on oil; the source of income is expected to decline within a few decades (Sivakumar & Sarkar, 2012). Therefore, Saudi Arabia strives to improve the SMEs' contribution to the country's GDP as the primary factor in becoming a developed country following the objectives of Saudi Arabia's Vision 2030 (Hunt, 2017). However, regarding the potential of SMEs, it is observed that programs, strategies, and governmental policies in Saudi Arabia focused on SMEs until recently (Rawashdeh & Al-namlah, 2017). However, the IT adoption among SMEs is still relatively low. Therefore, the ERP implementation has been gaining the attention of government agencies and academicians in the Saudi business environment.

ERP applications are very suitable for Saudi Arabian SMEs as they enhance their productivity and customer satisfaction responsiveness (Valdebenito & Quelopana, 2019). Saudi SMEs are, therefore, heading for more effective implementation of ERP despite the cultural differences compared with the western organizations, where ERP originated. Many Saudi SMEs and new businesses have set up their business profiles on Facebook, LinkedIn, and other related websites (Abed, 2020). This has been done in line with the Saudi government's 2030 vision to have ISs at the backbone of every initiative concerning the industry and particular service facilities.

2.2 The ICT and ERP in Saudi Arabia

Saudi Arabia has achieved considerable development in its ICT infrastructure. The government has provided extensive support and invested in a continued growth level in the ICT infrastructure (Al-Maliki, 2013). In 2015, ICT investments in Saudi Arabia totalled 17.83 billion Saudi Riyal (SAR). According to the Communications and Information Technology Commission (CITC, 2015), packaged and in-house developed software accounted for the highest share of ICT investments at 47%, followed by IT equipment investment at 26% and communications equipment at 27%. The CICT report (2015) revealed that Saudi Arabia is one of the fastest-growing IT markets in the Middle East (Alsayat & Alenezi, 2018), representing 50% of the total ICT investments in the Gulf Cooperation Council (GCC). Statistics also showed that about 80% of Saudi industrial companies use computers and their applications.

Furthermore, the CITC report (2015) stated that as of 2015, ICT services spending reached SAR 120 billion, with an annual growth rate of approximately 7%. Software sales, in general, in Saudi Arabia have grown at an annual rate of approximately 10 %. Saudi Arabia constitutes the most significant IT market in the Gulf region and will continue to be so in the future as it invests aggressively to upgrade its IT and communications infrastructure. In this regard, Alshehri and Drew

(2012) assert that various e-government projects, such as electronic tax systems, electronic payment gateways, and online information exchange have been successfully implemented in several business organizations in Saudi Arabia.

The number of Saudi Arabian companies adopting ERP systems is increasing rapidly, especially among large- and medium-sized organizations. Some adopted software system packages (e.g., SAP, ORACLE, PeopleSoft), while others have developed new local ERP systems (e.g., MADAR). However, the adoption of the ERP system by SMEs is a relatively recent phenomenon, as the ERP implementation projects are low and several years behind developed countries (Al-Bar & Hoque, 2019b). There is a reasonable number of Saudi companies which implemented the ERP system. Most ERP adopters were from the manufacturing and service industries. ERP applications, including Microsoft Dynamics, Oracle, SAP, MS Dynamics, or any home-grown ERP, are the most widely used in the world (Al-Jabri & Roztocki, 2015; Ruivo et al., 2015). However, many SMEs are reluctant to adopt an ERP system package, which can be attributed to the failure of ERP systems in many large companies in Saudi Arabia.

Saudi Arabia is not falling behind the developed countries in ERP adoption despite economic, socio-political, legal, and cultural differences. Although reliable statistics on the number of organizations in Saudi Arabia that adopted ERP systems since 2004 are unavailable, the Research Institute at King Fahd University of Petroleum and Minerals reported that more than 450 Saudi organizations had effectively implemented ERP by mid-2004 (Al-Turki, 2011). However, the number of organizations that adopted ERP systems could be estimated to be more than twice the number reported for 2004. This is due to the fast-growing level of economic development, along with the investments in IT adoption by the Saudi government after 2000 (Eid & Abbas, 2017).

Even though the ERP systems in Saudi Arabia have recorded a high implementation rate, the failure rate reached more than 90% (Saleh et al., 2013). The ERP system has been adopted in Saudi Arabia to align with the practical outcomes of many ERP implementation projects. Al-Turki (2011) reveals that most Saudi organizations have undergone severe time and cost overruns for ERP implementation practices. Many ERP systems eventually fail because the systems have not accomplished the desired strategic business goals (Althonayan & Althonayan, 2017). Therefore, it is pertinent to investigate the factors that affect the adoption of ERP in Saudi SMEs.

3 Methodology

This paper used quantitative research to collect data through a self-administered questionnaire. This method allows the researcher to evaluate behaviour and accurately present the findings. Moreover, survey research helps the researcher quickly and effectively collect data from a relatively large population.

The population of this study involves all the SMEs in Saudi Arabia. In contrast, the accessible (study) population would be comprised of SMEs (small and medium enterprises) operating in three main regions in Saudi Arabia, including Riyadh, Makah, and the Eastern region. These three main regions have the highest number of SMEs, including 121,189 small and medium

enterprises in Saudi Arabia. Therefore, the concentration of SMEs in these three regions is high, i.e., about 73 % (121,189 /166,639) of the total number of small and medium enterprises in Saudi Arabia.

A cluster sampling technique was used to select 576 determining sample sizes in different stages. The percentage of participants can be drawn from each region by dividing the determined sample size by the population of the study (i.e., 576 divided by 121,189, then multiplied by 100 = 0.475%). Then, determine the number of subjects in a sample by multiplying the total number of each element in the population by the determined percentage (i.e., 0.475), as shown in Table 1.

Table 1: Disproportionate Cluster Sampling of Respondents

Region	SMEs Population by Region	Disproportionate sample for each region
Riyadh	49,622	236
Makah	43,326	206
Eastern	28,241	134
Total	121,189	576

There are three stages of ERP implementation, namely evaluation (2 items), adoption (3 items), and routinization (5 items). For these three measures, the respondents of the study indicated on a 5-point Likert scale ranging from 1 = (strongly disagree) to 5 = (strongly agree) the extent to which they agreed with the statements, which evaluate the benefits of the implemented ERP system in the specified firm, the decision to use the ERP, and the routinization of the ERP system in the Saudi SMEs. The respondents also indicated on a 5-point Likert scale ranging from 1 = (strongly disagree) to 5 = (strongly agree) the extent to which they agreed with the statements, which describe the existence of ICT infrastructure in their SMEs to support the use of the ERP system.

4 Results and Discussion

4.1 Response Rate

In this study, 576 questionnaires were administered to the registered companies in Saudi Arabia. However, there were 363 returned questionnaires, with a response rate of 63.02%, and 334 valid questionnaires used in this study, with a final response rate of 57.99%. This percentage is considered adequate and higher than the 30% acceptable rate (Won et al., 2017), especially during the lockdown due to the coronavirus pandemic and the compulsory shutdown of most companies and businesses in Saudi Arabia.

4.2 Normality, Missing Values, and Outliers

Skewness and Kurtosis are statistical variables that are used to evaluate normality. When the skewness and Kurtosis are more than 2 and 7, it is considered a normality violation. The data typically showed a distribution that did not violate the assumption, as shown in Table 2. The normality of the outcomes of this study is within an acceptable range of the standard limit (Kline, 2015).

Table 2: Normal distribution of the study constructs

Variables	Skewness	SE	Kurtosis	SE
ERP_E	0.314	0.133	-1.212	0.266
ERP_A	0.324	0.133	-1.121	0.266
ERP_R	0.336	0.133	-0.769	0.266
ICT Infrastructure	0.497	0.133	-0.686	0.266

Missing information regarding the study variables may be considered one of the statistical analysis problems. No missing values were observed in the descriptive observation for the participants' demographics, work information, and responses. Tukey method was used to determine the outliers of the individual study constructs. No outliers were detected in the constructs of this study, as shown in Table 3.

Table 3: Detection of the outliers of study constructs

Variables	25th percentile	50th percentile	75th percentile	Tukey equation		Highest value	Lowest value
				= C1 + (1.5 (C1-A1))	= A1 - (1.5 (C1-A1))		
ERP_E	3.00	7.00	11.00	23	-9	15	3
ERP_A	4.00	7.00	11.00	21.5	-6.5	15	3
ERP_R	9.00	13.00	17.00	29	-3	25	5
ICT_ Infrastructure	4.00	7.00	10.00	19	-5	15	3

4.3 Measurement Model Assessment

The measurement model should be assessed through the outer measurement and the structural/internal model. The main parameters of the measurement model involve internal consistency reliability, indicator reliability, convergent validity, and discriminate validity (Ringle et al., 2015).

4.3.1 Internal Consistency Reliability

The internal consistency of the measurement model should be assessed to meet the standardization of academic research. Each construct's composite reliability (CR) should not exceed the threshold value of 0.70 (Hair et al., 2011). The composite reliability for the study constructs showed higher values than 0.70. The CR values of the ERP adoption, ERP evaluation, ERP routinization, and ICT infrastructure were 0.948, 0.943, 0.957, and 0.942, respectively. Therefore, the internal consistency was within the standard ranges for all the constructs of the present study.

4.3.2 Indicator Reliability

The indicator reliability of the measurement model is assessed by determining the loading values for items of the constructs of more than 0.50 (Sarstedt et al., 2017). In this paper, all the

items of constructs obtained loading values of more than 0.50. The loading values of the constructs' items ranged between 0.854- 0.973, as shown in Table 4. The results demonstrated satisfactory indicator reliability.

Table 4: Indicator reliability for the items of constructs

Constructs	Qs	1	2	3	4
ERP Adoption	1	0.947			
	2	0.919			
	3	0.916			
ERP Evaluation	1		0.934		
	2		0.910		
	3		0.917		
ERP Routinization	1			0.915	
	2			0.909	
	3			0.939	
	4			0.862	
	5			0.890	
ICT Infrastructure	1				0.875
	2				0.926
	3				0.953

4.3.3 Convergent Validity

The convergent validity is assessed in a measurement model by determining the average variance extracted (AVE). The AVE standard value should be equal to or higher than 0.50 for the constructs of the study (Hair et al., 2011). In this study, the constructs' AVE is higher than 0.50. The AVE of constructs of the present study is 0.860, 0.847, 0.816, and 0.844 for ERP Adoption, ERP Evaluation, ERP Routinization, Government Policies, and ICT Infrastructures, respectively.

4.3.4 Discriminant Validity

The discriminant validity of the measurement model is assessed by determining standard measures like Fornell and Larcker's criterion, cross-loadings, and heterotrait-to-monotrait. Fornell and Larcker's criterion determines the discriminant validity (Hair et al., 2013). Fornell and Larcker's criterion is acceptable if the latent value is higher than the square of the correlation between variables (Henseler et al., 2014). In this study, the values of Fornell and Larcker's criterion of each construct showed a higher value than the squares of correlations with latent variables, as shown in Table 5.

Table 5: Fornell and Larcker's criterion of constructs

	ERP A	ERP E	ERP R	ICT I
ERP Adoption	0.927			
ERP Evaluation	0.812	0.920		
ERP Routinization	0.804	0.746	0.903	
ICT Infrastructure	0.659	0.725	0.581	0.919

Table 6 illustrates all cross-loadings for the items of constructs used in the present study. All loading values output for each item of a specific construct should be higher compared with other latent values found for this item in other constructs. The blue highlighted values were higher than these items in other constructs. According to Table 6, the items and constructs are all acceptable regarding discriminant validity.

Table 6: Cross loadings of discriminant validity

	ERP A	ERP E	ERP R	ICT I
ERP Adoption (ERP A)	0.947	0.789	0.783	0.629
	0.919	0.725	0.677	0.538
	0.916	0.743	0.768	0.658
ERP Evaluation (ERP E)	0.759	0.934	0.672	0.656
	0.670	0.910	0.671	0.623
	0.807	0.917	0.714	0.717
ERP Routinization (ERP R)	0.764	0.706	0.915	0.554
	0.823	0.728	0.909	0.550
	0.773	0.733	0.939	0.566
	0.605	0.548	0.862	0.449
	0.640	0.631	0.890	0.491
Infrastructures (ICT I)	0.500	0.637	0.434	0.875
	0.662	0.674	0.558	0.926
	0.643	0.686	0.597	0.953

The heterotrait-to-monotrait (HTMT) is the most stringent statistical function used to identify the discriminant validity of previous tests. Authors like (Yusoff et al., 2020) suggest that a typical value should be less than 0.85, while other authors like (Febian & Syed Annuar, 2020) suggest that it should be less than 0.90. A previous study showed that the best value of HTMT should be less than 1.00 to approve discriminant validity (Benitez et al., 2020). The results of this study demonstrated that the HTMT values for all the constructs are less than 1.00.

4.4 Hypothesis Testing

The testing of hypotheses should be assessed by determining the path coefficient between the latent variables. The main requirements of approving the path coefficient start with the significance of p-values for all the paths, followed by the strength of correlation of each significant variable and the T statistical values. The path coefficient is measured as the ß value, where all the ß values of all paths should be more than 0.1 with significance and a T value higher than 1.96 to approve the hypotheses. Table 7 illustrates the hypotheses with bootstrapping results, including ß value, T statistic, and p-value. The following number of hypotheses are only significant with acceptable values of path coefficients, and T statistic values are H1c (ICT Infrastructures -> ERP Routinization). The supported hypotheses are highlighted in red based on previous outcomes obtained in the analysis. Table 7 shows that the ICT infrastructure has no significant relationship

with ERP adoption and evaluation. However, the results showed a significant relationship between the ICT infrastructure and ERP Routinization.

Table 7: Hypothesis testing results, coefficient, T statistics, and p-values

no.	Hypotheses	Std coefficient	T Statistics	P Values	Decision
H1a	ICT Infrastructures -> ERP Adoption	0.162	1.690	0.091	Not supported
H1b	ICT Infrastructures -> ERP Evaluation	0.147	1.688	0.092	Not supported
H1c	ICT Infrastructures -> ERP Routinization	-0.199	2.060	0.040	Supported

4.5 The Relationship between the ICT Infrastructure and ERP Adoption

The ICT infrastructure is the main factor associated with the system's development in any ERP organization (Nguyen et al., 2019). The ICT infrastructure generally influences all the models of the organization's performance and competencies (Jabbouria & Zaharib, 2015). This is because the effective use of the Internet and technology is the main requirement for success (Leandro et al., 2017). Al-Bar and Hoque (2019b) conducted a study to investigate the factors which affect the TOE framework. They found that ICT infrastructure is a significant factor in the ERP adoption stage for Saudi Arabian companies.

In another study, Zhu et al. (2006) reported a significant impact of the ICT infrastructure on the ERP implementation stages. Their study analyzed 1857 firms in 10 countries and found that the ICT infrastructure positively influenced the ERP evaluation and adoption; however, it negatively influenced the routinization. This study failed to reject the null hypothesis for the impact of the ICT infrastructure on ERP adoption and evaluation. Nevertheless, it significantly and negatively impacted the ICT infrastructure on the ERP routinization. A primary justification for the variance in the results among studies is the difference in the size of implementation and technology needs as an external influencer (Arslan, 2015). Since companies in Saudi Arabia have different levels of technology use in their systems and variation in their financial capabilities, the outcomes of this study could not verify the significant role of technology in the ERP implementation stages.

5 Conclusion

This paper investigated the relationship between information and communications technology (ICT) infrastructure and enterprise resource planning (ERP) adoption in small and medium enterprises (SMEs) in Saudi Arabia. Understanding the ICT infrastructure factors, which influence the implementation of the ERP system, can support the performance of employees and the quality of services provided by Saudi companies. Some factors that significantly influenced the adoption of the ERP system require some supportive factors from the government, directories, and technical teams to ensure the productivity and success of using various technological innovations. Therefore, the involvement of the Saudi government and technical experience should be emphasized in achieving successful organizations. Also, the organization's readiness and training on using the introduced technology can enhance the awareness of essential needs to understand

the importance of technology in performing the activities of the private commercial sector and developing the Saudi economy.

6 Availability of Data and Material

Data can be made available by contacting the corresponding author.

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