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Drivers of Global Social Network Adoption: A Technology-Organisation- Environment Perspective

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ABSTRACT

The aim of this study is to explore the drivers of social network adoption at a global level. The focus of past research has largely been placed on social network adoption at the country level with few studies conducted at the global level. Furthermore, the mediating role of ICT access on social network adoption has been given limited attention. To fill this gap, this study employs the Technology-Organization-Environment (TOE) framework to investigate factors that may influence global social network adoption. Relying on archival and cross-sectional data from 135 countries and using Partial Least Squares Structural Equation Modelling, our findings show that social network adoption at the global level, is positively influenced by ICT access of a county and that ICT regulation and the development of the human resource will not directly influence social network adoption. Though technological, organizational, and environmental factors all together accounted for 55.5% of the variance in social network adoption, the mediating role of ICT access and the effects of human resource development on social network adoption was found to be significant. Our findings provide a fresh insight into the adoption of social network sites at the global level. Our study provides some implications for research and practice.

KEYWORDS

Human Resource Development, ICT Access, Political and Regulatory Environment, Social Network Adoption

1. INTRODUCTION

In this modern era, social network sites (SNS) have become an essential medium for communication among individuals, families, and firms (Larosiliere & Leidner, 2012) within and across nations. With the prevalence of SNS sites such as WhatsApp, Facebook, Twitter among others, individuals can easily communicate, create and share information from any part of the world (Larosiliere, Carter, & Meske, 2017). According to a Statista (2018) report, the number of SNS users around the globe in the year 2017 stood at approximately 2.46 billion, an increase of over 50 million from the 2014

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number of users that stood at 1.91 billion. However, it is predicted that the number of SNS users worldwide will increase to over 3.02 billion in the year 2021. The increase in SNS use globally can be attributed to the increasing usage of mobile devices which has enabled mobile social networking applications and allows individuals to access visual blogging sites which so much ease (Clement, 2018). As at the fourth quarter of 2018, five countries were ranked with the highest number of social media users. This included; China, India, United States (US), Brazil and Indonesia with number of users approximately standing at 673 million, 326 million, 243 million, 95 million and 85 million respectively (Statista, 2019a). Furthermore, Facebook which is currently the world's SNS market leader in terms of reach and scope boast of 2.3 billion active monthly users worldwide with YouTube and WhatsApp been its close competitor having 1.9 and 1.6 billion active users worldwide (Statista, 2019b). Boyd & Ellison (2007a, p. 211) defined SNS as “web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system”. One extraordinary element of SNS is that they do not only allow individuals to meet with strangers, but also enables individuals to connect and make known their social networks (Boyd & Ellison, 2007b).

Over the last decade, the world has experienced an increase in technological innovations. This rise has led to the acceptance of technological innovations by individuals and businesses around the globe. As such, Information Systems (IS) researchers have delved into studies that explores the critical factors that influence the adoption or acceptance of these technologies in contexts such as financial technologies (Chuang, Liu, & Kao, 2016; Ryu, 2018; Yonghee, Young-Ju, Jeongil, & Jiyong, 2016), e-business and e-government (Elenezi, Tarhini, Masa'deh, Alalwan, & Al-Qirim, 2017; Srivastava & Teo, 2010; Krishnan et al., 2013; Richter et al., 2009). However, whilst research on SNS adoption has also been widely explored, only a few studies examine its adoption at the global level (Larosiliere et al., 2017; Sun & Wang, 2012; Krishnan et al., 2013). This is because social media adoption has widely been seen as an individual phenomenon investigated at the individual level and this presents a narrow view of social network adoption. The few studies that have examined social media adoption at the global level have largely concentrated on the effects of internal resources such as technological, organizational and environment on SNS adoption at the national level (Larosiliere et al., 2017). Research on the relationship that exists between the major internal factors such as technology, organization, and environment at the global level and how they affect SNS adoption at the global level is lacking.

This study, therefore, seeks to examine the direct effects of these factors (ICT access, Human development, and the regulatory environment) on SNS adoption at the global level. We also examine the mediating role of ICT access on SNS adoption at the international level. To do this, we use data from 135 countries and the technology-organization-environment framework as the study's theoretical lens. The rest of the paper is structured as follows; we introduce the theoretical framework and the development of the hypotheses in section 2, the research methodology in section 3. In sections 4 and 5 we analyse the data and present our findings. In section 6, the paper concludes the overall findings, contribution. It also presents the limitations of the study as well as future research directions.

2. THEORY AND HYPOTHESIS DEVELOPMENT

2.1. Technology-Organization-Environment (TOE) Framework

To undertake this study, we rely on the Technology-Organizational-Environment framework (TOE) developed by DePietro, Rocco, Wiarda, Edith & Fleischer, Mitchell (1990). TOE is an organizational level framework that seeks to explain the process through which a firm or organization adopts and implements technological innovations. TOE indicates that the process of adopting and implementing technological innovations within an organization is determined by the technological, organizational

and environmental contexts (DePietro, Wiarda & Fleischer, 1990). The technological context argues that adoption relies on the blend of technologies within and outside of the organization in addition to the organization's perceived relative advantage, observability, compatibility, complexity and trialability (Awa, Ukoha & Emecheta, 2012). The organizational context is made up of the characteristics and resources of the firm, this includes but not limited to; human resources, the size of the firm, degree of formalization, the amount of slack resources and managerial structure. Finally, the environmental context is made up of the size and structure of the industry in which the firm operates, the firm's competitors, the regulatory environment and the macroeconomic context (DePietro, Wiarda, & Fleischer, 1990). These 3 factors or constructs together influence a firm's technology adoption decision.

Numerous researchers have adopted TOE to undertake studies in different domains. This includes the use of TOE in the adoption of inter-organizational systems (Al-Hujran, Al-Lozi, Al-Debei, & Maqableh, 2018; Bhattacharya & Wamba, 2015; Gangwar, Date, & Ramaswamy, 2015; Ka & Kim, 2014; Mishra et al., 2007), electronic data interchange (Musawa & Wahab, 2012; Kuan & Chau, 2001), e-business (Soto-Acosta, Popa, & Palacios-Marqués, 2015; Wen & Chen, 2010; Durbhakula & Kim, 2011; Krishnan & Teo, 2011; Zhu et al., 2003; Zhu & Kraemer, 2005, Zhu et al., 2004), enterprise systems (Ramdani et al., 2009), open systems (Chau & Tam, 1997) and a broad scope of general information systems (IS) applications (Thong, 1999). Also, due to the informative power of the TOE, it has been adopted in extant studies across several domains among which are; country and industry contexts (Khan & Krishnan, 2019; Larosiliere, Carter, & Meske, 2017; Srivastava & Teo, 2010). At the national level, for example, Srivastava & Teo (2010) in their study relied on the TOE framework to examine the adoption of Information Technology (IT) innovations in 113 countries. Their findings revealed that IT infrastructure (Technological), quality of human capital (Organizational) and quality environment (Environment) positively affects a country's adoption of ICT. Furthermore, they indicated that government assistance and the existence of a robust institutional environment are the most essential promoters of e-government and e-business development in a country. Similarly, the study of Larosiliere et al., (2017) on SNS adoption at the national level using 135 countries revealed that SNS adoption at the national level is positively influenced by technology maturity (Technology), citizens' readiness (Organization) and ICT laws (Environment). Though valuable, these studies failed to examine the relationship between the various constructs of the TOE framework (that is, technology, organizational and environment) and how they subsequently affect SNS adoption. Expanding on previous studies, we adopt the TOE framework to examine the effect of ICT access (Technology), skilled labour (human resource development) and regulatory environment (Environment) on social network adoption at country level, taking into consideration the relationship that exists between the three major constructs and how they subsequently affect SNS adoption at the country level.

The rest of this chapter develops the hypotheses within the technological, environmental and organizational contexts.

2.2. Technological Context

A country's technological infrastructure aids the adoption of different kinds of ICTs. Krishnan et al. (2013), Lin and Lin (2008), Srivastava and Tao (2010) in their respective studies indicates that the maturity of a country's technological infrastructure plays a major role in IT innovation and adoption at the organizational and national level. Furthermore, technological readiness which includes technology infrastructure, as well as the available range of technologies, is also critical to a country's adoption of ICTs (Oliveira and Martins, 2008; Scupola, 2009). However, the effect of citizens access to ICTs on the adoption of SNS is scant. In this study, we argue that the citizen's access to various ICTs positively influences the adoption of SNS. Furthermore, we rely on indicators such as; fixed telephone subscriptions, households with internet access, households with a personal computer, internet bandwidth per user and mobile cellular subscriptions from the ICT Development Index (2016) to measure ICT access. Drawing on these we hypothesize that:

H₃: The level of ICT access in a country is positively associated with its social network adoption.

2.3. Organizational Context

Organizational context involves the characteristics and resources of the organization. This includes the size of the organization, degree of formalization, managerial structure, level of centralization, human resources (HR) and linkages among employees (Tornatzky & Fleisher, 1990). Bogaert, Martens & Cauwenbergh (1994) highlighted that HR is possibly the most essential resource for organizational development. Applying this to the country level, we postulate that the education and training of individuals within a country positively influence the adoption of SNS. Human capital in relation to education and training has been identified as an important driver for e-government and e-business use and development (Srivastava & Tao, 2010; Von Haldenwan, 2004). Similarly, Larosiliere, Carter, and Meske (2017) in their study found out that a country's organizational resources positively influence its citizen's adoption of SNS. Expanding these, we posit that, human resource development in a country will positively affect social network adoption. Based on this, we hypothesize that human resource of a country measured in terms of adult literacy, expected years of schooling, mean years of schooling and gross enrolment ratio (Human Capital Index, 2016) positively affects SNS adoption. We state our second hypothesis by indicating that:

H₁: The level of human resource development in a country is positively associated with its social network adoption.

Furthermore, we argue that higher human resource development within a country achieved through education and training of nationals within a country will enhance the adoption and use SNS. We draw from the study of Srivastava & Teo (2010) who found that educated and trained individuals within a country are better ready to use web services which could lead to e-business development within a country. Similarly, Lazarević and Lukić (2016) indicate that employees are the most essential resource in an organization in terms of their knowledge, skills, and potentials and this crucial factor determine the ICT adoption and use in various ways. We extend findings from previous studies to the country level by arguing that, the level of human resource development in a country positively affects ICT access. A well-educated and trained human resource will be better equipped to use SNS and as a result, they will have an increase in ICT access as they understand the benefits that come with using SNS. This leads to our third hypothesis:

H₂: The level of human resource development in a country is positively associated with its level of ICT Access.

Previous studies have largely focused on how the organizational context influences IT adoption at the national level (Khan & Krishnan, 2019; Srivastava & Teo, 2010). We emphasize that, once citizens possess a high level of education and training, their level of compliance with regulations may be more positive than if they were illiterate or uneducated. The level of compliance can affect the ethical use or otherwise of technology in a country. Therefore, the level of human resource development can affect the level of ICT related legislation promulgation, compliance and enforcement. Based on this we hypothesize that:

H₄: The level of human resource development in a country is positively associated with its level of ICT Regulation.

2.4. Environment Context

The Environmental context is made up of the size and structure of the industry in which a firm operates, the regulatory environment and the macroeconomic environment (Tornatzky & Fleisher, 1990; Zhu, et al. 2002). Earlier research on environmental factors have focused on consumer readiness, competitive pressure, regulatory environment, external support, catalyst agent, the complexity of a firm's value chain, trading partner support (Bhattacharya & Wamba, 2015; Gangwar et al., 2015; Scott, 2007; Tornatzky & Fleisher, 1990; Zhu, Kramer, Xu, & Dedrick, 2004; Gibbs & Kraemer, 2004). Studies at the global level have examined the environmental construct in terms of ICT laws or ICT oriented legal framework, institutional and economic environments (Khan & Krishnan, 2019; Larosiliere et al., 2017; Srivastava & Teo, 2010). Khan and Krishnan (2019) conducted a cross-analysis study to explore the impact of ICT laws on ICT diffusion within 90 selected countries. Their findings revealed that sound ICT laws within a country ensure a great diffusion of ICT among nationals, businesses, and government. They further stated that ICT laws facilitate the legal framework for gathering, processing, storing and disseminating electronic information. Similarly, Larosiliere et al., (2017) found that environmental factors largely influence the adoption of SNS in a country. Expanding on these studies, we hypothesize that, the environmental context which we refer to as ICT regulation (comprising of the effectiveness of law making bodies (ELMB), efficiency of legal systems in challenging regulation (ELSCR), efficiency of legal systems in settling disputes (ELSSD), intellectual property protection (IPP), judicial independence (JI), laws relating to ICTs (LR ICTs), software piracy rate (SPR), number of procedures to enforce a contract (PEC) and number of days to enforce a contract (DEC) as indicated in Table 1) has a positive influence on SNS adoption. Therefore, our hypothesis states that:

H₆: The level of ICT regulation of a country is positively associated with its social network adoption.

Past studies that relied on the TOE framework has largely focused on how the environmental context affects the adoption of technology (Al-Hujran et al., 2018; Bhattacharya & Wamba, 2015; Soto-Acosta et al., 2015; Wen & Chen, 2010). Country-level research has also focused on the effect of the environmental context on citizen's adoption of a technology (Khan & Krishnan, 2019; Larosiliere et al., 2017; Srivastava & Teo, 2010). Therefore, relying and expanding on previous studies, we argue that, there exists a relationship between the environmental context (represented by the political and regulatory environment in this study) and the technology context (represented by ICT access). We further argue that the level of ICT regulation in a country influences the level of ICT access of citizens within the country. If there exist rigid ICT laws within a country, the level of ICT access available to citizens in the country is affected. We, therefore, hypothesize that:

H₅: The level of ICT regulation of a country is positively associated with its level of ICT access.

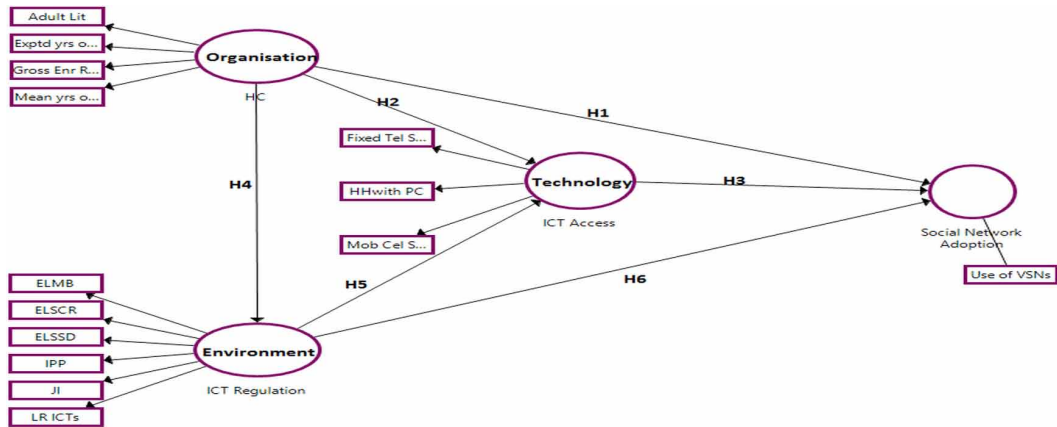
Figure 1 presents the research model with all the hypotheses.

3. RESEARCH METHODOLOGY

3.1. Data

To test the hypothesis outlined in our research model in Figure 1, data was collected from multiple archival sources. These sources included the World Economic Forum (WEF) Global Competitiveness Report (GCR) (World Economic Forum, 2016), United Nations Development Programme (UNHDI, 2016), and World Economic Forum (WEF) Global Information Technology Report (GITR) (Ballar, Dutta, & Lanvin, 2016). These different secondary data sources were combined for all countries where complete data were available. This was because data was needed for a large number of countries to

Figure 1. Research model



conduct the study at the aggregated national level. The variables used were taken from these various reports, the study considered only data for those countries that were available in all reports. The common data points were analysed across all the reports and these resulted in 135 countries for analyses. The indicators that had less than 5% of the data missing was mean-replaced (Hair Jr, Hult, Ringle, & Sarstedt, 2016).

3.2. Constructs, Variables, and Measures

Four latent variables were considered in this study. These were human resource development, ICT access, political and regulatory environment, and social network adoption. The human resource development construct is measured four indicators of adult literacy, the gross enrolment ratio, expected years of schooling and the mean years of schooling for each country. This was drawn from the Human Capital Index from the 2016 World Development Report. ICT access refers to communication technologies that provide access to information. This includes the Internet, wireless networks, cell phones, and other communication mediums. This is measured by indicators such as fixed telephone subscriptions, households with internet access, households with personal computers, internet bandwidth per user and mobile cellular subscriptions. ICT access is a sub-index of the ICT development index drawn from the 2016 International Communications Union (ITU) report (ITU, 2017). The political and regulatory environment is the first pillar of the World Economic Forum (WEF) Global Information Technology Report (GITR) (Baller et al., 2016) which consist of nine variables that assess the extent to which the national legal framework facilitates ICT penetration and the safe development of business activities. It considers general features of the regulatory environment such as the protection afforded to property rights, the independence of the judiciary, and the efficiency of the law-making process as well as more ICT-specific dimensions such as the passing of laws relating ICTs and software piracy rates. The social network adoption construct is measured by use of virtual social networks gleaned from the 2016 GITR. The item assesses the overall use of virtual social networks such as Facebook, Twitter, LinkedIn, etc. by the public for personal and professional communication. The WEF’s Global IT Report (Baller et al., 2016) provides the measure that captures the extent of social network usage by individuals represented in different countries. Table 1 provides a summary of the latent variables, the indicators and the sources of the data. The acronyms for each indicator used in the model are also provided.

Table 1. Summary of constructs, indicators, and sources of data

SN	Latent Variable	Measure/Indicator	Acronym	Source of Data
1a	Human Development/ Skilled Labour	Adult Literacy	Adult Lit	Human Capital Index from the World Development Report 2016
b		Gross Enrollment Ratio	Gross Enr Ratio	
c		Expected Years of Schooling	Exptd yrs of sch	
d		Mean Years of Schooling	Mean yrs of sch	
2a	ICT Access	Fixed Telephone Subscription	Fixed Tel Subs	ICT Development Index, International Communications Union (ITU)
b		Household with internet access	HH with internet acc	
c		Households with Personal Computer	HH with PC	
d		Internet Bandwidth per User	Int Bdw per User	
e		Mobile Cellular Subscriptions	Mob Cel Subs	
3a	Political and Regulatory Environment	Effectiveness of law-making bodies	ELMB	World Economic Forum, Network Readiness Index Report 2016
b		Laws relating to ICTs	LR ICTs	
c		Judicial independence	JI	
d		Efficiency of legal system in settling disputes	ELSSD	
e		Efficiency of legal system in challenging regs	ELSCR	
f		Intellectual property protection	IPP	
g		Software piracy rate, % software installed	SPR	
h		No. procedures to enforce a contract	PEC	
i		No. days to enforce a contract	DEC	
4	Social Network Adoption	Use of virtual social networks		World Economic Forum, Network Readiness Index Report 2016

3.3. Justification for Using PLS-SEM

The study used partial least squares structural equation modelling (PLS-SEM) over covariance-based SEM techniques such as LISREL or AMOS for a number of reasons. The study found the use of PLS-SEM useful because it offers solutions with small sample sizes, especially when the models used comprises of many constructs and a large number of items (Fornell & Bookstein, 1982; Hair, Hult, Ringle, Sarstedt, & Thiele, 2017; Willaby, Costa, Burns, MacCann, & Roberts, 2015). It does this by using the PLS-SEM to compute partial regression relationships in the measurement and structural models through the use of separate ordinary least squares regressions. Secondly, the absence of distributional assumptions is the main reason for the choice and use of PLS-SEM (do Valle & Assaker, 2016; Hair, Sarstedt, Ringle, & Mena, 2012; Nitzl, 2016) because of the reliance on non-normal data in the social sciences. Thirdly, PLS-SEM is suitable for exploratory research with secondary data, because it offers the flexibility for the interplay between theory and data (Nitzl, 2016). Furthermore, the increasing popularity and use of secondary data analysis (i.e. data from company databases, social media, customer tracking, national statistical bureaus or publicly available survey data) shift the research focus from strictly confirmatory to predictive. Such research settings are a perfect fit for the prediction-oriented PLS-SEM approach (Hair, Risher, Sarstedt, & Ringle, 2019).

Lastly, in using PLS-SEM, there is a benefit from the method’s high degree of statistical power compared to covariance-based SEM (Hair et al., 2017; Reinartz, Haenlein, & Henseler, 2009). The reliance on PLS-SEM for greater statistical power means that it is more likely to identify relationships as significant when they are indeed present in the population (Sarstedt & Mooi, 2019).

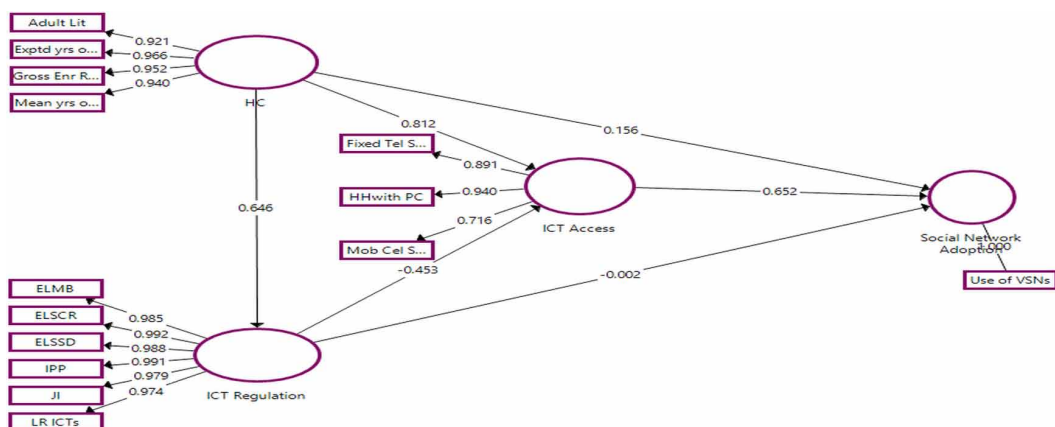
4. DATA ANALYSIS AND RESULTS

To conduct the data analysis, SmartPLS was used as the data analysis tool in order to explore the role human resource development and the political and regulatory environment plays on the effects of ICT access to the social network development of a country. SmartPLS is a professional statistical software that uses a graphical user interface for structural equation modelling (SEM) using the partial least squares (PLS) path modelling method. Apart from estimating path models with latent variables using the PLS-SEM algorithm, the software calculates standard results assessment criteria (for reflective and formative measurement models, the structural model, and the goodness of fit) (Ringle, Wende, & Becker, 2015). An assessment of the measurement and structural model was performed to evaluate the model.

4.1. Assessment of the Measurement Model

All the constructs were reflective and so the measurement model was tested for reliability and validity before an assessment of the structural model. The assessment included the estimation of internal consistency for reliability, convergent validity, and discriminant validity (Hair et al., 2019). The first step in the reflective measurement model assessment is to examine the indicator loadings. Loadings above 0.708 are recommended (Hair et al., 2019). This is because they indicate that the construct explains more than 50 percent of the indicator’s variance, and therefore provides acceptable item reliability. Each construct loaded significantly on their corresponding constructs (Gefen & Straub, 2005) and these were all higher than the cut-off point of 0.708 depicted in Figure 2 (Hulland, 1999). This means that each of the indicators was a good measurement of the latent constructs. The minimum indicator loading was 0.716. The construct reliability and validity were assessed severally. The internal consistency, Cronbach’s alpha and Fornell-Larker’s composite reliability (Fornell & Larcker, 1981; Jöreskog, 1971) were used. The coefficients of the Cronbach’s Alpha have all exceeded the minimum of 0.7 (Nunnally, 1978) and were from 0.812 to 1.000. Though Cronbach’s alpha is a measure of internal consistency reliability, which assumes similar thresholds, it, however, produces lower values than composite reliability. Specifically, Cronbach’s alpha is a less precise measure of reliability, as the

Figure 2. Results of PLS analysis



items are unweighted. The rho A is an alternative and an approximately exact measure of construct reliability (Dijkstra & Henseler, 2015). Rho A also exceeded a minimum of 0.7. The composite reliabilities also exceeded the minimum of 0.7 and were considered to be adequate (Fornell & Larcker, 1981). This showed that there was adequate internal consistency. The third step assessed for convergent validity of each construct measure. Convergent validity is the extent to which the construct converges to explain the variance of its items. The metric used for evaluating a construct’s convergent validity is the average variance extracted (AVE) for all items on each construct. An acceptable AVE is 0.50 or higher indicates that the construct explains at least 50 percent of the variance of its items. All the Average Variances Extracted (AVEs) were greater than the 0.5 recommended minimum (Fornell & Larcker, 1981; Hair et al., 2019). Table 2 displays the Construct Reliability and Validity.

Table 2. Construct reliability and validity

	Cronbach’s Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
HC	0.960	0.962	0.971	0.893
ICT Access	0.812	0.870	0.889	0.730
ICT Regulation	0.994	0.999	0.995	0.970
Social Network Adoption_	1.000	1.000	1.000	1.000

The fourth step was to assess discriminant validity. Discriminant validity is the extent to which a construct is empirically distinct from other constructs in the structural model. To assess the discriminant validity, the cross-loading was examined. From Table 3 the loadings for each construct exceed the cross-loadings. For example, Adult Lit loads high on its corresponding construct HC

Table 3. Indicator cross loadings

	HC	ICT Access	ICT Regulation	Social Network Adoption_
Adult Lit	0.921	0.456	0.536	0.466
Exptd yrs of sch	0.966	0.434	0.688	0.408
Gross Enr Ratio	0.952	0.514	0.605	0.464
Mean yrs of sch	0.940	0.551	0.609	0.521
Fixed Tel Subs	0.451	0.891	0.000	0.572
HHwith PC	0.575	0.940	0.144	0.751
Mob Cel Subs	0.245	0.716	0.010	0.533
ELMB	0.588	0.015	0.985	0.080
ELSCR	0.599	0.015	0.992	0.104
ELSSD	0.581	-0.002	0.988	0.079
IPP	0.677	0.112	0.991	0.172
JI	0.649	0.135	0.979	0.199
LR ICTs	0.698	0.116	0.974	0.195
Use of VSNs	0.493	0.733	0.145	1.000

(0.921) but much lower on constructs ICT Access (0.456) ICT Regulation (0.536) and Social Network Adoption (0.466). Therefore, the analysis of the cross-loadings suggests that discriminant validity has been established.

Further assessment of discriminant validity was the Fornell-Larcker criterion (Fornell & Larcker, 1981). This construct suggests that each construct’s AVE should be compared to the squared inter-construct correlation (as a measure of shared variance) of that same construct and all other reflectively measured constructs in the structural model. The shared variance for all model constructs should not be larger than their AVEs (Fornell & Larcker, 1981; Hair et al., 2019). From Table 4 the diagonals are the square root of the AVE of the latent variables and indicate the highest in any column or row and this portrays adequate discriminant validity.

Table 4. Fornell-Larcker criterion

	HC	ICT Access	ICT Regulation	Social Network Adoption_
HC	0.945			
ICT Access	0.519	0.854		
ICT Regulation	0.646	0.071	0.985	
Social Network Adoption	0.493	0.733	0.145	1.000

Henseler, Ringle, and Sarstedt (2015) indicate that the Fornell-Larcker criterion does not perform well, especially when the indicator loadings on a construct differ only slightly (e.g. all the indicator loadings are between 0.65 and 0.85). They, therefore, proposed the heterotrait-monotrait (HTMT) ratio of the correlations (Voorhees, Brady, Calantone, & Ramirez, 2016). The HTMT is defined as the mean value of the item correlations across constructs relative to the (geometric) mean of the average correlations for the items measuring the same construct. Discriminant validity problems are present when HTMT values are high. A threshold value of 0.90 is proposed for structural models with constructs that are conceptually very similar. This means that an HTMT value above 0.90 would suggest that discriminant validity is not present. Bootstrapping was also applied to test whether the HTMT value is significantly different from 1.00 (Henseler et al., 2015). To do this, we examined if the upper bound of the 95 percent confidence interval of HTMT is lower than 0.90. Table 5 shows the Heterotrait-Monotrait Ratio (HTMT) and Table 6 shows the Heterotrait-Monotrait Ratio (HTMT).

Table 5. Heterotrait-Monotrait ratio (HTMT)

	HC	ICT Access	ICT Regulation	Social Network Adoption_
HC				
ICT Access	0.561			
ICT Regulation	0.656	0.096		
Social Network Adoption_	0.502	0.806	0.141	

Table 6. Heterotrait-Monotrait ratio (HTMT)

	Original Sample (O)	Sample Mean (M)	Bias	2.50%	97.50%
ICT Access -> HC	0.561	0.603	0.042	0.241	0.961
ICT Regulation -> HC	0.656	0.635	-0.021	0.29	0.849
ICT Regulation -> ICT Access	0.096	0.21	0.114	0.052	0.138
Social Network Adoption_ -> HC	0.502	0.526	0.024	0.252	0.795
Social Network Adoption_ -> ICT Access	0.806	0.809	0.003	0.685	0.889
Social Network Adoption_ -> ICT Regulation	0.141	0.184	0.044	0.039	0.608

4.2. Assessment of the Structural Model

Multicollinearity was assessed for each of the independent constructs by examining the variance inflation factor (VIF). A minimum threshold of 5 or lower is needed to avoid the collinearity problem (Hair, Ringle, & Sarstedt, 2011). The rule of thumb is that each of the predictor construct's VIF values must be lower than 5 in order to indicate that the variable under consideration is almost a perfect linear combination of independent variables already in the equation (Hair et al., 2011; Hair et al., 2016; Mansfield & Helms, 1982). All of the VIF values were below 5 in this study confirming that multicollinearity was not a problem in the study. Table 7 shows the Multicollinearity Statistics: Inner VIF Values.

Table 7. Multicollinearity statistics: Inner VIF values

	HC	ICT Access	ICT Regulation	Social Network Adoption_
HC		1.717	1.000	2.796
ICT Access				1.636
ICT Regulation		1.717		2.054
Social Network Adoption_				

The hypotheses were tested for significance. This was done by assessing the paths of the structural model when the path coefficients between the constructs were calculated and the significance of the path coefficients and the significance levels were evaluated. In order to obtain the *t*-values in SmartPLS 3.2.8, we performed a bootstrapping procedure using a two-tailed *t*-distribution. The bootstrapping was run using 5000 re-samples. The results are presented in Tables 8, 9 and 10, and supported by Figure 2.

In relation to Table 8 which presents a breakdown of the hypothesis results, it is important to note that of the six hypotheses proposed in this study, three were not supported. The specific indirect effects were tested further and the findings revealed that no specific indirect effect was supported. The findings related to the individual hypotheses are discussed in the following section below. Figure 3 shows Model Hypothesis Testing for Direct Effects. Table 10 shows the T-Statistics of Outer Loadings.

To evaluate the structural model in order to determine its predictive power, the coefficient of determination (R^2) was used. The coefficient represents the exogenous latent variables' combined

Table 8. Structural model hypothesis testing for direct effects

Hypothesis	Relationship	Std Beta	Std Error	T Statistics (IO/STDEV)	Decision	95% CI LL	95% CI UL
H ₁	HC -> Social Network Adoption_	0.189	0.135	1.158*	Not Supported	-0.006	0.446
H ₂	HC -> ICT Access	0.845	0.115	7.031**	Supported	0.684	1.072
H ₃	ICT Access -> Social Network Adoption_	0.616	0.138	4.736**	Supported	0.304	0.769
H ₄	HC -> ICT Regulation	0.631	0.14	4.614**	Supported	0.347	0.818
H ₅	ICT Regulation -> ICT Access	-0.43	0.276	1.643*	Not Supported	-0.866	0.045
H ₆	ICT Regulation -> Social Network Adoption_	0.012	0.106	0.02*	Not Supported	-0.167	0.172

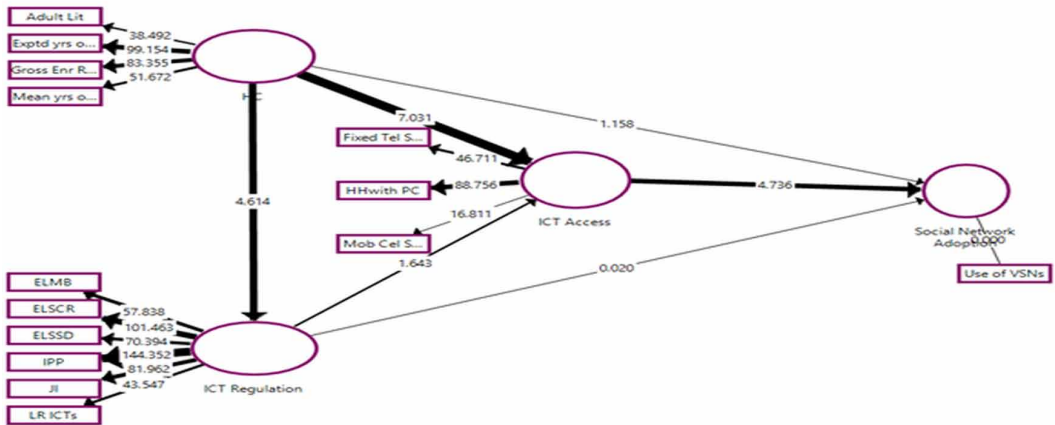
Table 9. Structural model hypothesis testing for indirect effects

Hypothesis		Std Beta	Std Error	T Statistics (IO/STDEV)	P Values	Decision	95% CI LL	95% CI UL
H ₇	HC -> ICT Regulation -> ICT Access	-0.299	0.224	1.311*	0.19	Not Supported	-0.729	0.008
H ₈	HC -> ICT Access -> Social Network Adoption_	0.525	0.146	3.639**	0	Supported	0.213	0.731
H ₉	ICT Regulation -> ICT Access -> Social Network Adoption_	-0.29	0.182	1.621*	0.105	Not Supported	-0.607	0.01
H ₁₀	HC -> ICT Regulation -> ICT Access -> Social Network Adoption_	-0.202	0.15	1.277*	0.202	Not Supported	-0.495	0.004
H ₁₁	HC -> ICT Regulation -> Social Network Adoption_	0	0.072	0.019*	0.985	Not Supported	-0.2	0.064

Table 10. T-statistics of outer loadings

	HC	ICT Regulation	ICT Access	Social Network Adoption
Adult Lit <- HC	38.492			
Exptd yrs of sch <- HC	99.154			
Mean yrs of sch <- HC	51.672			
Gross Enr Ratio <- HC	83.355			
ELMB <- ICT Regulation		57.838		
ELSCR <- ICT Regulation		101.463		
ELSSD <- ICT Regulation		70.394		
LR ICTs <- ICT Regulation		43.547		
IPP <- ICT Regulation		144.352		
JI <- ICT Regulation		81.962		
Fixed Tel Subs <- ICT Access			46.711	
HHwith PC <- ICT Access			88.756	
Mob Cel Subs <- ICT Access			16.811	
Use of VSNs <- Social Network Adoption_				Single Item Construct

Figure 3. Model hypothesis testing for direct effects



effects on the endogenous latent variable (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). From Table 11 the coefficient of determination, R^2 is 0.389 for ICT Access, which means that the two latent variables (HC and ICT Regulation) explain 38.9% of the variance in ICT Access. Also, ICT Regulation, ICT Access, and HC together explain 55.5% of the variance of Social Network Adoption, whilst HC explains 41.8% of ICT Regulation. The R^2 ranges between 0 to 1 with higher values indicating higher levels of predictive accuracy.

Table 11. R Squared

	R Square	R Square Adjusted
ICT Access	0.389	0.380
ICT Regulation	0.418	0.413
Social Network Adoption_	0.555	0.545

In addition to checking for collinearity, the effect size of the model was assessed. This shows how much an exogenous latent variable contributes to an endogenous latent variable's R^2 value. The rule of thumb is that $0.02 < f^2 < 0.15$ is weak; $0.15 < f^2 < 0.35$ is moderately weak and $f^2 > 0.35$ has a strong effect. Table 12 shows the f square.

Table 12. f square

	HC	ICT Access	ICT Regulation	Social Network Adoption_
HC		0.628	0.717	0.019
ICT Access				0.584
ICT Regulation		0.196		0.000
Social Network Adoption_				

5. DISCUSSION OF RESULTS

From the analysis of the results, several findings emerged. Out of the six hypotheses that were set out in the model in Figure 1, three were supported. First, the hypothesis that the level of human resource development in a country is positively associated with its level of ICT Access was supported. This is supported by Lazarević and Lukić (2016) that employees being the most important resource in an organization in relation to their knowledge, skills and potentials are a crucial factor that determines ICT applications and adoption. Nationally, the human resource development in the context of literacy rates, years of schooling and enrolment ratios will go a long way to determine the level of access of a country's population to the available ICTs. Bankole, Shirazi, and Brown (2011) examines the impact of ICT investments on human development and show that the four dimensions of ICT investment impacts on human development in various ways. They argue that where such investment has been a purely techno-centric approach it has led to failures in developing countries. With empirical evidence that the relationship between ICT and human development is limited (Bankole et al., 2011) this study sheds light on the human development-ICT access nexus to support the hypothesis that the level of a country's human resource is positively associated with how the general population will leverage on ICT through its accessibility.

On the level of ICT access in a country being positively associated with its social network adoption, the findings supported a positive association. Extant literature indicates that Internet access remains stratified by sociocultural and economic differences. These may be by old or young, gender, racial/ethnic minorities, less educated, living alone, unemployed, and sometimes even people who have lower income are less likely to be online (Elliot, Mooney, Douthit, & Lynch, 2013; Van Deursen & Helsper, 2015). Whilst these access gaps may be generational and temporal, evidence suggests that among those who are not online, older adults are less interested in getting Internet access than younger adults (Lenhart, Rainie, Fox, Horrigan, & Spooner, 2000), perhaps because older adults do not integrate the Internet into their daily lives as deeply as their younger counterparts. As Internet access is more ubiquitous and pervasive among younger adults who are presumed to be the active part of a country's population, it is assumed that the socio-cultural and economic differences in Internet access may eventually close as younger generations replace older ones (Yu, Ellison, McCammon, & Langa, 2016). In a similar study by Larosiliere, Meske, and Carter (2015) they argued that a high level of internet users is critical in promoting the successful adoption of SNS within a country. This is because they argue that social network utilization requires a stable ICT infrastructure to support the public's utilization. Social networking sites facilitate the communication of information and so its functions can be properly utilized and the benefits realized if people in a country have access to ICTs.

Finally, the level of human resource development in a country was found to be positively associated with its level of ICT Regulation. To support this, we draw on the fact that the linkage between ICTs and economic development has been widely explored (Hassen & Svensson, 2014; Heeks, 2010), to the extent that the economic future of a country may depend on the degree to which information and communication technologies (ICTs) diffuse among its key stakeholders-citizens, businesses, and government. However, extant literature points to a dearth of literature on a cross-country analysis of ICT diffusion that examines technology diffusion among key stakeholders such as citizens, business and government. In addition to this, there is a limited understanding of the impact of ICT laws on ICT diffusion among stakeholders across countries. In this study, the findings suggest that sound ICT laws are necessary for achieving a greater diffusion of ICTs among citizens, businesses, and the government in a country (Khan & Krishnan, 2019) but this is dependent on the level the country's human resource development. Therefore, a country's highly developed human resource is likely to have a positive association with the level of ICT regulations because the ICTs regulations are more likely to comply with when the population is more literate.

Three hypotheses in our model were not supported. Our findings did not support the positive association of the level of human resource development in a country with its social network adoption.

However, when the study further tested for indirect effects of human resource development on social network adoption through ICT access, the findings were found to be significant. This means that whilst human resource development per se may not guarantee the social network adoption in a country, this can be enhanced through the provision of ICTs to enable the populace to have access and these can, in turn, ensure social media adoption (See Table 9). The findings did not also support the positive association of the level of ICT regulation of a country with its level of ICT access and the hypothesis that the level of ICT regulation of a country is positively associated with its social network adoption was also rejected.

6. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

Conclusively, our findings emphasise the role of ICT regulation, ICT access, and human resource development by indicating that these three constructs together explain 55.5% of the variance of social network adoption of a country. This study concludes that the level of a country's human resource is positively associated with how the general population will leverage on ICT access. The study also holds that the level of ICT access in a country is positively associated with its social network adoption and that the more access a country's population has access to ICTs, the more the citizens will adopt social networks. Finally, we conclude that the level of human resource development in a country is linked positively with its level of ICT regulation.

Our study reveals some important contributions. First, existing studies indicate that social network adoption, at the country level, is positively influenced by the technological maturity, public readiness, and information and communication technology law sophistication (Larosiliere et al., 2015), our study adds to the body of knowledge by arguing that the role of ICT access and human resource development in the country-level social network adoption discourse is very important. The study does this by proving the indirect effects of ICT access in influencing the effect of human development of a country in national social network adoption. Second, this study is one of the very few studies to examine how the role of human resource development and ICT access on social network adoption at the country level. It does this by pointing out that though the TOE framework which has been largely applied at firm-level can be applied at the national level and that technology (ICT access), organisation (human resource development) and environment (ICT regulations) are critical components of the global adoption of social network sites. These components are as critical to firm country-level adoption of technological innovation as they are at the firm level.

From a practical viewpoint, our study makes two important contributions. It does this by first making it possible for practitioners and policymakers to understand the impact of human resource development such as level of education and access to ICTs on social network adoption at the national level. This knowledge can inform practitioners and policymakers in examining the influencing factors of social network adoption at the country level, especially in the implementation of e-government services that may be tied to social networks.

Our study is however limited by our reliance on secondary data obtained from different sources. This led to our reliance on the indices as formulated by the reporting agencies. We could have relied on primary data to ensure better control over the definition of the variables in the study, but this was not feasible for us to undertake such a large-scale cross-country data collection exercise considering the limited amount of resources and time at our disposal. However, these indices have been formulated by reputable and authorized organizations through the use of suitable statistical procedures. Second, the data used was only from the countries with commonly available data from all the sources. Therefore, we could not include some countries because their data was not commonly available in all the sources. However, discarding some of the countries did not make a significant difference in the results because PLS-SEM places minimal restrictions on sample size and residual distributions (Chin, 1998).

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APPENDIX: LIST OF COUNTRIES INCLUDED IN THE ANALYSIS

Albania
Algeria
Argentina
Armenia
Australia
Austria
Azerbaijan
Bahrain
Bangladesh
Belgium
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Bulgaria
Burundi
Cambodia
Cameroon
Canada
Cape Verde
Chad
Chile
China
Colombia
Costa Rica
Côte d'Ivoire
Croatia
Cyprus
Czech Republic
Denmark
Dominican Republic
Ecuador
Egypt
El Salvador
Estonia
Ethiopia
Finland
France
Gabon
Gambia
The Georgia
Germany
Ghana
Greece
Guatemala
Guinea

Guyana
Haiti
Honduras
Hong Kong SAR
Hungary
Iceland
India
Indonesia
Iran-Islamic Rep
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Korea
Rep. Kuwait
Kyrgyz Republic
Lao PDR
Latvia
Lebanon
Lesotho
Liberia
Lithuania
Luxembourg
Macedonia
Madagascar
Malawi
Malaysia
Mali
Malta
Mauritania
Mauritius
Mexico
Moldova
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
Netherlands
New Zealand
Nicaragua
Nigeria
Norway
Oman

Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Romania
Russian Federation
Rwanda
Saudi Arabia
Senegal
Singapore
Slovak Republic
Slovenia
South Africa
Spain
Sri Lanka
Swaziland
Sweden
Switzerland
Tanzania
Thailand
Trinidad and Tobago
Tunisia
Turkey
Uganda
Ukraine
United Arab Emirates
United Kingdom
United States
Uruguay
Venezuela
Vietnam
Zambia
Zimbabwe

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