

Research Article

Empirical Evaluation of Iranian CIO Perspective with Adoption of Green Information Technology

Farkhondeh Mortaz Hejri ¹, Reza Radfar,² Masoud Zohrabi,³ and Zeynab RabieiPakdeh⁴

¹Department of IT Management, Faculty of Management, South Tehran Branch, Islamic Azad University, Tehran, Iran

²Industrial Management Department, Science and Research Branch, Islamic Azad University, Tehran, Iran

³Department of Information Technology Management, Faculty of Management and Accounting, Allameh Tabataba'i University, Tehran, Iran

⁴Department of Public Administration, Faculty of Management and Accounting, Allameh Tabataba'i University, Tehran, Iran

Correspondence should be addressed to Farkhondeh Mortaz Hejri; fmortazh@gmail.com

Received 15 June 2022; Revised 31 July 2022; Accepted 9 August 2022; Published 31 August 2022

Academic Editor: Reza Lotfi

Copyright © 2022 Farkhondeh Mortaz Hejri et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In recent decades, green aspects became a key priority for governments worldwide, as sustainable policies are able to promote a more equitable society and a healthier economy from the social, economic, and environmental perspectives, in addition to preserving natural resources for future generations. As an essential context in information technology management, green information technology (GIT) has been developed to cope with the existing environmental problems through organizations. The present study is aimed at identifying the influential factors of decision-making on the adoption of GIT. To collect the required data, interviews were performed along with a structured survey. A total of 112 questionnaires were delivered to chief information officers (CIOs), 99 of which underwent the analysis. The structural equation and partial least square approaches were adopted for data analysis. GIT driver (G-driver) was found to be an intermediary parameter. Findings revealed the GIT readiness (G-readiness) and GIT context (G-context) result in in GIT adoption whenever there was a G-driver indicator (i.e., ethical driver, economic driver, response driver, or regulatory driver). The present study found the significance of all the variables to be above 1.96 except G-context → green intention to adoption path and G-readiness → green intention to adoption. Considering that the determination of coefficients and the analysis of relationships between factors directly depends on the opinion of experts and if the opinion of expert's changes, the results will also change; this can be mentioned as the most important limitation of the research. Therefore, it should be noted that the largest impact was identified to be posed by the economical driver.

1. Introduction

Green information and communication technology (ICT) innovations are key to achieving global climate goals. Cross-border technological cooperation has become a strategic choice for countries to achieve technological breakthroughs [1]. Rapid advancement in ICT is promoting us into an era of unprecedented prosperity and countless possibilities. However, there is one gloomy side of the ICT technology that contributes toward the inflation of carbon footprint [2]. Today, the increasing use of technology and the industrial revolution are affecting the economy and the environment, such as the development of economies and the increase of

the ecological footprint (EFP) [3]. PERCCOM (PERvasive Computing and COMmunications in sustainable development) Masters is the first innovative international program in green ICT for educating and equipping new IT engineers with green IT skills for sustainable digital applications design and implementation [4]. Today, the assessment of skills in the field of acquiring green skills has increased. In extensive studies, a list of recommendations for environmental development has been provided.

Organizations consider green improvement and environmental sustainability as significant strategic dimensions since they associate with large regulatory, economic, and social pressure [5] and impose challenges to international

markets. Furthermore, senior managers have understood the environmental impacts of information technology (IT). They realize that it is important to reduce environmental impacts [6]. IT components have large power consumption rates. The CO₂ emission of IT components is believed to be as high as that in the aviation field [7]. Moreover, climate change and global warming along with energy cost enhancement have imposed a significant challenge on the global economy. To generically respond to such problems, it is required to consider corporate sustainability and corporate social responsibility (CSR) [8].

The term green information and communication technology (green ICT) has been recently employed in academic works and expert papers [9]. It refers to the ability of a corporation to make systematic use of corporate sustainability components for designing, producing, sourcing, utilizing, and disposing of the technological ICT infrastructure as in the managerial and human components of the present ICT infrastructure [10]. In fact, green ICT mainly deals with the environmental impacts posed in the entire lifecycle of IT, including ICT device design, utilization, and management [24]. Today, researchers refer to green ICT as a green approach for most organizations [11].

Green ICT is a key enabler of a green economy [12]. To aid policy makers in promoting green ICT at the national level, this paper proposes a comprehensive understanding of green ICT from the perspective of green innovation for Iranian CIOs and develops an analytical framework based on innovation system approaches. Following the framework, policy makers can formulate policies to solve them. Therefore, green ICT adoption within organizations could be described to be an essential metric of corporate sustainability and success in the economy and green productivity. However, such metrics involve legislation requirements, economic achievements, ethical proofs, and shareholder commitment. Such factors are essential for the study and identification of possibly influential dimensions in green ICT adoption. However, the major factors of adopting green ICT by senior managers and decision-makers in organizations remain yet to be clarified. The present study seeks to realize the readiness factors and metrics that motivate organizations to implement green ICT measures in Iran. The findings of the present work would help explain green ICT adoption in Iranian organizations from an IT management perspective. For this purpose, the main objective of the present study is to extract the influential GIT adoption factors in the views of CIOs in Iranian organizations. Therefore, the main contribution of the research is as follows:

- (i) We show the factors that influence the adoption of GIT in Iranian organizations from the point of view of senior managers.
- (ii) Development of a model to demonstrate the impact of GIT to provide an efficient package that controls the performance of organizations.

The remainder of the study is organized as follows: Section 2 reviews the literature and background; Section 3

describes the methodology, including statistical processes and analytical framework; Section 4 analyzes the results; Section 5 provides managerial insights of research; and Section 6 concludes the work and makes suggestions.

2. Theoretical Foundations

ICT may have two-way environmental impacts. On the one hand, each ICT lifecycle stage may add to environmental destruction. On the other hand, it is possible that ICT offers a number of suitable instruments to measure, report, and diminish the emissions of greenhouse gases, water utilization, and waste production in core organizations and value chain procedures. GIT typically refers to the utilization of environmental criteria regarding ICT [8]. Gartner [13] proposed a CIO role-based definition of GIT. Most CIOs consider the emission of greenhouse gases and IT order to be the main aspects. More importantly, CIOs help their organizations deal with environmental sustainability at the enterprise scale. However, they also offer analytical instruments, technical/analytical understandings, and leading the changes in the current data centers [8]. The decisions of a CIO influence the entire organization since IT systems currently drive every business process in organizations. Mangal [14] suggested that CIOs would be a primary shareholder in the environmental footprint improvement of organizations. They believed that CIOs could make a significant contribution to planet sustainability improvement. IT is the main factor of environmental footprint in organizations. However, the proper management of IT could yield solutions helping diminish not only the environmental footprints in organizations but also the costs. By implementing effective calculations and a focus on unique opportunities, IT managers establish green investment solutions. Furthermore, senior IT officers have significant data analysis capabilities. Thus, they codify, formulate, and implement green solutions. IT managers perform green intellectual leadership in their organizations and receive significant support. To achieve sustainability commitment in activities, CIOs and green policies should be employed in organizations. To meet environmental criteria and cope with the associated concerns, CIOs investigate practices and policies fitting the requirement of the organization prior to technology decision-making. This has a strong influence on the environmental footprint of the organization. To this end, organizations require green techniques and technologies allowing for the evaluation, management, and reduction of energy consumption as well as w-waste production [15].

The utilization of IT has heavily enhanced the water consumption of organizations. Datacenter cooling accounts for the largest portion of water consumption in organizations. Energy consumption evaluation in an organization enables the CIO to realize how water consumption could be diminished. The saving of water could bring substantial cost and energy savings. There are several technologies, including waterside and airside economization, to evaluate and monitor water consumption. Furthermore, a number of recently developed servers make use of innovative cooling

techniques, including built-in pumps and muffins. This property reduces the consumption of water. DC power could also be applied to data centers for water and energy consumption reduction [16]. It is also possible to decrease water consumption in organizations by the reuse of strongly treated wastewater to cool data centers and meet other water demands in IT-intense corporate settings.

Additionally, to reduce the environmental footprint of organizations, it is important that CIOs safely dispose of IT devices with e-waste (e.g., cartridges, laptops, and computers). This is of particular importance concerning short-lifecycle IT devices. It is not reasonable to throw e-waste into the trash and dispose of it within landfills since toxic substances could seep from such waste into water resources. The IT management contributions to the creation and utilization of green technology solutions could be classified into three groups, including the following:

- (1) responsibility for IT effectiveness and efficiency through green strategy identification within the organization,
- (2) supporting and implementing green measures and plans across the organization, and
- (3) working for business benefits as intellectual leaders by deriving optimal solutions from GIT and the realization of GIT strategies.

2.1. Literature Review

2.1.1. Review. GIT is multifaceted in nature. Thus, researchers have proposed a large number of theories and frameworks, including adoption. Adoption-related studies focus on the process of adopting and implementing GIT along with internal and external factors motivating and affecting the adoption of GIT. For example, the technology-organization-environment (TOE) framework was developed as a popular theory. It suggests that three factors influence the adoption and deployment of innovative technologies in organizations. Such groups include environmental, organizational, and technological factors [17]. A large number of studies on new technology adoption employed TOE in several fields, including GIT [18], e-commerce [19], and e-business [20, 21].

The models developed concerning technology adoption deal with technological determinations of innovation adoption and diffusion. Despite possible similarities, green technology adoption differs from the adoption of other technologies in some aspects [22]. Researchers have traditionally considered environmental compliance to impose an additional cost on businesses. Thus, managers have concerns about the possible negative impacts of these initiatives on the competitiveness of their businesses [23]. For the explanation of GIT adoption, it is required to take into account the entire adoption domains. A review of the literature on the adoption of e-commerce, IT, green technologies, and innovations revealed that researchers have proposed several models for the adoption of GIT on the grounds of the IT adoption

literature. For example, Zahng and Liang [18] proposed a framework based on innovation system approaches for promoting green ICT in China. For this purpose, a comprehensive understanding of green ICT from the perspective of green innovation is proposed and an analytical framework based on innovation system approaches is developed. Papoli et al. [2] presented a comprehensive survey on green ICT. For this purpose, the survey discussed both aspects of ICT, i.e., green of ICT and green by ICT. Firstly, the recent approaches for the greening of ICT include techniques for green data center and green mobile networks. Li et al. [1] investigated the structural characteristics and influence mechanism of green ICT transnational cooperation network. For this purpose, 49,731 patents used social network analysis method (SNA) and quadratic assignment procedure (QAP) to discuss the structural features and influence mechanisms of the worldwide green ICT cooperation network from 2000 to 2019. Kahouli et al. [3] investigated the relationship between ICT, green energy, total factor productivity, and ecological footprint. For this purpose, we focused on the Kingdom of Saudi Arabia (KSA) to assess the impact of ICTs, green energy (renewable energy and electric power consumption), and economic activities (total factor productivity: TFP) on the environmental quality (EFP) by applying the Johansen cointegration technique and vector error correction method (VECM). Ofori et al. [24] examined the direct and indirect effects of ICT diffusion on inclusive growth in 42 Africa countries over the period 1980–2019. Robust evidence is provided to several specifications from the dynamic system GMM to show that (i) ICT skills, access, and usage induce inclusive growth in Africa countries and (ii) the effects of ICT skills, access, and usage are enhanced in the presence of financial development. Evangelista and Hallikas [25] explored the influence of ICT adoption on sustainability practices in purchasing and supply management (PSM) as well as its effects on purchasing performance. To accomplish this objective, a comprehensive review of the literature was conducted. A number of such works are summarized in Table 1.

2.1.2. GIT Context. The context of GIT evaluates the current features of technology adoption frameworks. In TOE, such contexts are classified by GITAM into three contexts, including environmental, technological, and organizational. GIT has distinct intention to use and actual adoption since research has recently shown that a number of managers in organizations need to implement robust measures, even when they have environmental concerns and intend to take actions accordingly [22, 3]. Thus, there is a gap between awareness and action.

Concerning the technological context, it should be noted that GIT is expected to flourish wherever significant IT assets have been implemented. The pressure of power cost enhancement and the challenge of housing, cooling, and powering technologies are greater where high-density servers are employed. As a result, servers of higher energy efficiency and/or the virtualization and consolidation of

TABLE 1: A summary of GIT adoption works.

Author(s)	Paper	Method
[18]	Promoting green ICT in China: a framework based on innovation system approaches	Structural equation model
[26]	Drivers for green IT in organizations: multiple case studies in China and Singapore examining the drivers for green IT initiatives of companies in the Asia Pacific region	Bibliography
[27]	GIT adoption: a managerial perspective to investigate how organizational factors affect the formation of an organizational decision maker's intention to green IT adoption through the mediation of managerial perceptions	Structural equation model
[28]	A research agenda on managerial intention to green IT adoption: from norm activation perspective, the current study adopts a norm activation model in organizational context to investigate how an intention to green IT adoption is formed (norm activation model (NAM))	Structural equation model
[29]	Organizational green IT adoption: concept and evidence They provided a comprehensive review to explain the reasons for GIT adoption in organizations	Bibliography
Alemayehu Molla and Ahmad Abareshi [30]	Organizational green motivations for information technology: empirical study	Structural equation model
Shaun Thomson and Jean-Paul van Belle [31]	Antecedents of GIT adoption in south African higher education institutions	Structural equation model
[32]	GIT adoption: influential factors and extension of planned behavior theory	Structural equation model
[2]	A comprehensive survey on green ICT with 5g-Nb-iot: towards sustainable planet	Bibliography
Kahouli et al., 2022	Investigating the relationship between ICT, green energy, total factor productivity, and ecological footprint: empirical evidence from Saudi Arabia	Structural equation model
[1]	Research on the structural features and influence mechanism of the green ICT transnational cooperation network	Bibliography
Ofori et al. [24]	Inclusive growth in sub-Saharan Africa: exploring the interaction between ICT diffusion and financial development	Structural equation model
Evangelista and Hallikas [25]	Exploring the influence of ICT on sustainability in supply management: evidence and directions for research	Bibliography

servers could be adopted [33]. The utilization of green logistics and manufacturing techniques also falls in the technological context.

The organizational context deals with the descriptive business characteristics, including corporate citizenship, size, and sector. Sectors may make different responses to GIT. As it is directly involved in environmental policies, a utility company (e.g., a power, gas, or oil company) is a more probable candidate of early GIT adoption.

Regarding the environmental context, it is worth noting that TOE involves regulatory settings as an essential component for the creation of permissive and conducive settings to promote the utilization of GIT measures. Governmental organizations may promote GIT adoption through legislation enabling a low-carbon economy.

2.1.3. Green IT Drivers. An economic driver represents the necessity of higher IT efficiency and pursuing significant savings in costs in IT operations. Global business expansion and storing numerous data copies for regulation compliance and meeting strategies implemented for the continuity of businesses substantially enhance data storage. Corporate data amounts increased above 10^6 TB in 2007. It was estimated to rise above 1 ZB in 2010 (IDC in Brocade, 2007). Economic drivers such as cost diminishing are among substantial GIT drivers [34]. Due to increased energy costs,

energy consumption reduction is known as a major ICT-related cost reduction strategy [35, 36].

Regulatory drivers (including regulatory adherence) make essential contributions to the organizational intention to adopt GIT. Organizations are required by specific regulations to provide CO₂ emission reports above a predefined level [18, 48]. More importantly, actions arising from the necessity of meeting certain regulations (either voluntary or mandatory ones) are emphasized. GIT guidelines have been developed by some intergovernmental, professional, and national organizations. Some organizations may not intend to adopt GIT. Regulatory driver predominance could result in a minimalistic approach to the adoption of GIT. It may promote GIT practices, such as IT procurement of environmental preference, IT carbon footprint evaluation, green power proportion enhancement, and IT end-of-life (EoL) management. The ethical driver represents pursuing business exercises of social responsibility and good corporate citizenship. Given that the green movement influences the entire corporate life aspects, organizations increasingly attempt to be socially recognized to be concerned about social responsibility in both local and global communities [37]. Businesses make use of CSR initiatives for enhancing their brand awareness among crucial shareholders, such as the general public, consumers, and investors [38]. It is reasonable to view self-motivation as an ethical driver in GIT implementation. GIT could be implemented on the grounds

of the overall beliefs and perception of organizations for doing the common good. This could arise from the understanding of the cost benefits for gradually establishing confidence among the employees or even directing the ambitions and hopes toward brand image improvement [39].

2.1.4. Response Drivers. Market opportunities involve the increasing knowledge of the environmental impacts of ICT and the consideration of ICT to be an approach to dealing with those impacts. Today, businesses can implement sustainable ICT measures and supply green ICT software and equipment [36, 40]. Political, cultural, and social pressure may serve as a great driver for the awareness of GIT and, consequently, its adoption. This could occur whenever environmental degradation is appreciated by society, realizing its essentiality. This would drive organizations to adopt different approaches [36]. It is also possible that an organization is obliged to adopt GIT measures to meet industrial requirements (of other enterprises). The adoption of sustainable techniques by an organization invariably drives other related organizations to implement sustainable exercises [36]. Molla and Abareshi [41] proposed response drivers by integrating the political, cultural, and social drivers with industry and market opportunity drivers.

2.1.5. GIT Readiness. GIT readiness dynamically evaluates the preparation of the environment and organizations to adopt GIT. It involves perceptual features in the context of adoption. It was suggested that the same number of organizational and external environment characteristics appear to be secondary as the number of innovation characteristics known to be secondary [42]. Based on this suggestion, Molla and Licker [43] argued that two organizations with the same organizational resource level and context may differently perceive the readiness level and differently make decisions on adoption. Thus, one can extract three GIT readiness dimensions from the PERM of Molla and Licker [43] including institutional, value-network, and organizational dimensions.

Organizational GIT readiness refers to the GIT-related resources, commitment, and awareness of an organization. The degree of concerns about the social and environmental IT has an impact on business and IT leaders services as an essential factor for GIT initiation.

Moreover, value-network GIT readiness represents to what extent the suppliers, consumers, investors, and rivals of a company are ready for GIT. Concerning the readiness of suppliers, some vendors perform the marketing of their products as green measures. IT vendors are at the center of GIT agendas [44].

Regarding government GIT readiness, it should be noted that governments can have effects on GIT via rendering direct subsidies. Since governments are major IT users, they can serve as leaders and develop a norm for the utilization of GIT. Professional institutions commonly make use of significant influence concerning professional exercises. In turn, this could have GIT adoption implications.

2.1.6. Research Gap. According to the previous study, the present study developed a theoretical model on the basis of GITAM proposed by Molla [18]. Molla [18] sought to propose a novel theory on GIT adoption on the grounds of the available adoption and innovation frameworks. GITAM combined two models in the form of theoretical background. PERM and TOE were built as second-order facilitating components. It was argued that drivers (i.e., strong-order reasons), in combination with these components, could affect the GIT adoption process and content. For the identification of GIT drivers, earlier works developed the organizational motivation theory, as shown in Figure 1 [45]. GITAM suggests that GIT drivers, GIT context, and GIT readiness affect the intention of organizations to adopt GIT.

3. Methodology

As it sought to extract factors that impact GIT adoption from an IT management perspective, the present study has applied research in terms of objectives. Furthermore, the findings of the present work could be helpful to organizations in reducing costs and environmental impacts through the green management of IT. As this study provides a representation of the current situation, it adopts a descriptive methodology. Data were collected using questionnaires. Therefore, the present study is a survey. This study is a correlational research in terms of data analysis and employs the structural equation method (SEM). The scale of the data is sequential since the Likert scale was applied. The statistical population consisted of IT managers in governmental and private organizations.

To calculate the content and face validity of the questionnaire, content validity index (CVI), and content validity ratio (CVR), the views of twelve experts were exploited. Furthermore, Cronbach's alpha was employed to evaluate questionnaire reliability. It was calculated for twenty respondents. Alpha was found to be above 0.75 for the entire variables. The measurement instrument of the variables was concluded to be sufficiently and property reliable.

Once the respondent characteristics had been described by descriptive statistical indexes, partial least square-structural equation modeling (PLS-SEM) was applied to analyze the responses. As a multivariate method, PLS-SEM has recently been popular [46]. It is a strong and competent instrument that applies few constraints on the measurement scales. PLS-SEM helps model nonnormal latent constructs [47]. To carry out PLS-SEM, the validity and reliability of the measurement model should be ensured. Also, ordinary least square regression is noniteratively applied to derive the outer weights, structural relationships, and loads of manifest and latent constructs. Eventually, bootstrap resampling is employed for the statistical significance evaluation of the paths.

Google forms were employed to deliver the questionnaires. CIOs received the questionnaires during April-September 2017. The selected CIOs were IT experts, including senior managers at IT companies and IT faculties. A total of 112 collected responses were subjected to reliability and usability screening.

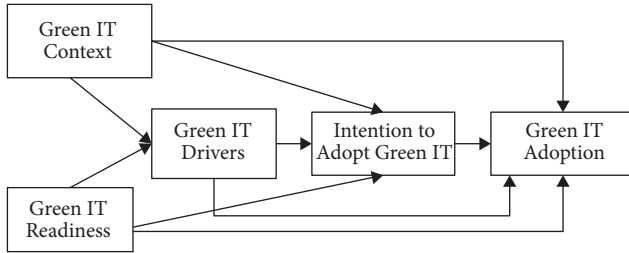


FIGURE 1: Basic GITAM framework [18].

3.1. Data Analysis Method. The proposed framework for establishing the proposed model in this research, which is based on structural equations, is generally possible in four stages as follows:

- (1) Identify effective factors of CIO Perspective in GIT
- (2) Determine the impact of each factor on CIO Perspective in GIT
- (3) Calculate the degree of relationship between observe and latent factors
- (4) Introduce a structural equation model and how to convert the current situation to the proposed desired situation

Phase 1. Identify effective factors of CIO Perspective in GIT.

Tool: questionnaire.

In this step, we first divide the influencing factors into two groups of observed and hidden variables. Observed variables are those variables that are determined using an internal systematic study as criteria that can affect the organization's process. Studying the observed variables in organizations is important because it can always be useful for the analyst in identifying the hidden variables of the organization in question. But in order to study and perform statistical analysis, we must divide these variables into groups, so that we put the observed variables that are related to each other in one category, which are actually the same hidden variables. In this case, the latent variables cover the observed variables. It should be noted that in conceptual model design, hidden variables are always like model nodes. To achieve these variables, the use of data collection tools is a key factor. Questionnaire in this field can be of great help to an analyst. Before preparing the questionnaire, the necessary information should be collected using the library method. To complete this section, by reading books, articles, and research in the relevant field, the most important obvious variables can be found in this regard.

Phase 2. Determine the impact of each factor on CIO Perspective in GIT.

Tools: LISREL software.

This stage is implemented with the aim of providing a conceptual model of the organizational process that can show the relationships between factors well. In other words, at this stage we seek to determine the logical relationships between the hidden variables and other variables. Latent

variables are divided into dependent variables and independent variables. Coefficients are actually what we are looking to calculate, based on which the relationship of variables is measured. The coefficient of an independent latent variable is equal to λ , the coefficient of an independent latent variable is equal to γ , and the coefficient of a latent variable is equal to β . If the coefficient is less than 0.3, the relationship is considered weak and we ignore that relationship. A factor loading between 0.3 and 0.6 is acceptable, and a factor loading greater than 0.6 is considered very favorable. The purpose is to determine the coefficients between the variables identified in the organization. For this purpose, a preliminary conceptual model should be designed at this stage.

Phase 3. Calculate the degree of relationship between observe and latent factors.

Tools: LISREL software.

At this stage, after designing the initial model in LISREL software and running the implementation from the initial model, the coefficients are determined by the software if the variables and the model have adequate overlap. At this stage, it is necessary to report the output of the software in different modes such as ESTIMATED and STANDARD to check the estimated coefficients.

Phase 4. Introduce a structural equation model and how to convert the current situation to the proposed desired situation.

In this step, according to the output of LISREL software, the value of P statistic for the model is calculated. Considering that the statistical analysis is performed in the 95% confidence interval; if the P value is calculated to be less than 0.05, the model is statistically significant. In general, the lower the value of P, the better. Therefore, it can be concluded that the estimated model has good accuracy. In the ESTIMATED mode, if the variables have the interval range specified in the second phase, we select and leave the other variables. Finally, the path that leads us to the goal is chosen as the dominant strategy over other strategies.

4. Findings

According to the observed cases, the influencing factors on Iranian CIO have been identified from the perspective of GIT. Based on that, hypotheses and subhypotheses are considered as follows:

The main hypotheses are as follows:

H13: GIT readiness has a positive effect on the intention to adopt GIT.

H14: GIT context has a positive effect on the intention to adopt GIT.

H15: GIT drivers have a positive effect on the intention to adopt GIT.

The main subhypotheses are follows:

H1: Professional and governmental institutions have a positive effect on GIT readiness.

H2: Organizational, technologies, monitoring, governance, strategy, policies, and attitude have a positive effect on GIT readiness.

H3: Value network GIT readiness perception influences GIT readiness perception.

H4: Environmental context has a positive effect on GIT context.

H5: Organizational context has a positive effect on GIT context.

H6: Technological context has a positive effect on GIT context.

H7: Economic benefits have a positive effect on GIT drivers.

H8: Ethical organizational beliefs have a positive effect on GIT drivers.

H9: Response drivers have a positive effect on GIT drivers.

H10: Regulatory has positive effects on GIT drivers.

H11: GIT readiness has a positive effect on GIT drivers.

H12: GIT context has a positive effect on GIT drivers.

To perform PLS-SEM, model block unidimensionality should be investigated. A unidimensional block is characterized by Cronbach's alpha and composite reliability (CR) above 0.7 [47]. These values are reported in Table 2. As can be seen, Cronbach's alpha was found to be in the range of 0.70–0.95, while CR was calculated to be 0.92–0.96. Thus, the values are all above 0.7. Furthermore, the estimation results of the measurement model (i.e., average variance extracted (AVE), outer loads, and outer weights) are provided in Table 3. Outer loads stand for the loads of reflective manifest variables and their respective latent variables. They help evaluate the reliability of individual items. A load above 0.7 demonstrates the reliability of the corresponding item [48]. The present study calculated the entire outloads to be above 0.7. AVE is employed for evaluating convergent validity. The present work obtained AVE to be 0.55–0.80 for the variables. As can be seen, AVE was greater than 0.5. Also, the AVE squared roots of the constructs were derived to be above the construct correlations. Once the measurement model had been validated, the structural model was estimated to relate the latent variables.

Figure 2 illustrates the path coefficients of the endogenous latent variables along with the corresponding coefficient of determination (R^2). H1 and H2 were supported by the empirical findings. However, H3 was not supported.

Once the measurement models were examined, the proposed structural model was investigated. Unlike the measurement model, the structural model associates with the latent variables rather than the observed variables; the latent variables are related in this phase. To evaluate the fitness of the proposed structural model, a number of criteria were incorporated, including the significance coefficient (i.e., t -values). The significance coefficient was calculated using bootstrapping in Smart PLS. To fit the structural model

TABLE 2: CR, Cronbach's α , and AVE.

	Cronbach's α	CR	AVE
Economical driver	0.847	0.908	0.766
Environmental context	0.803	0.884	0.718
Ethical driver	0.733	0.834	0.628
G-context	0.893	0.919	0.627
G-drivers	0.897	0.919	0.551
G-readiness	0.943	0.951	0.622
Government	0.851	0.910	0.771
Green intention to adoption	0.868	0.919	0.791
Organizational readiness	0.854	0.896	0.633
Organizational context	0.701	0.803	0.578
Regulatory driver	0.903	0.932	0.775
Response driver	0.703	0.821	0.697
Technological context	1	1	1
Value network	0.921	0.944	0.808

TABLE 3: Path coefficients.

Coefficients	t -statistic	P -value	Result
Economical \rightarrow G-drivers	17.27	0.001	Confirmed
Environmental \rightarrow G-context	20.91	0.001	Confirmed
Ethical driver \rightarrow G-drivers	5.84	0.001	Confirmed
G-context \rightarrow G-drivers	3.00	0.003	Confirmed
G-context \rightarrow green intention to adoption	0.44	0.654	Rejected
G-drivers \rightarrow green intention to adoption	14.54	0.001	Confirmed
G-readiness \rightarrow G-drivers	2.251	0.025	Confirmed
G-readiness \rightarrow green intention to adoption	1.057	0.291	Rejected
Government \rightarrow G-readiness	18.809	0.001	Confirmed
Organizational \rightarrow G-readiness	18.491	0.001	Confirmed
Organizational context \rightarrow G-context	12.998	0.001	Confirmed
Regulatory driver \rightarrow G-drivers	20.973	0.001	Confirmed
Response driver \rightarrow G-drivers	4.052	0.001	Confirmed
Technological context \rightarrow G-context	4.058	0.001	Confirmed
Value network \rightarrow G-readiness	17.95	0.001	Confirmed

via coefficient calculation, the obtained values should be above 1.96. In such a case, the significance is verified at a confidence level of 0.95%. The present study found the significance of all the variables to be above 1.96 except G-context \rightarrow green intention to adoption path and G-readiness \rightarrow green intention to adoption.

Considering the exclusion of the removed paths, the final model for Iranian CIOs from the perspective of GIT is according to Figure 3.

The quality index of the structural model represents its ability to forecast observed variables based on the corresponding latent variables. The main model involves both the structural and measurement models. The fitness verification of the model completes the fitness test. For the fitness evaluation of a model, the goodness of fit (GOF) index is employed. A GOF of 0.01, 0.20, and 0.36 represents weak, moderate, and strong goodness of fit. These values stand for

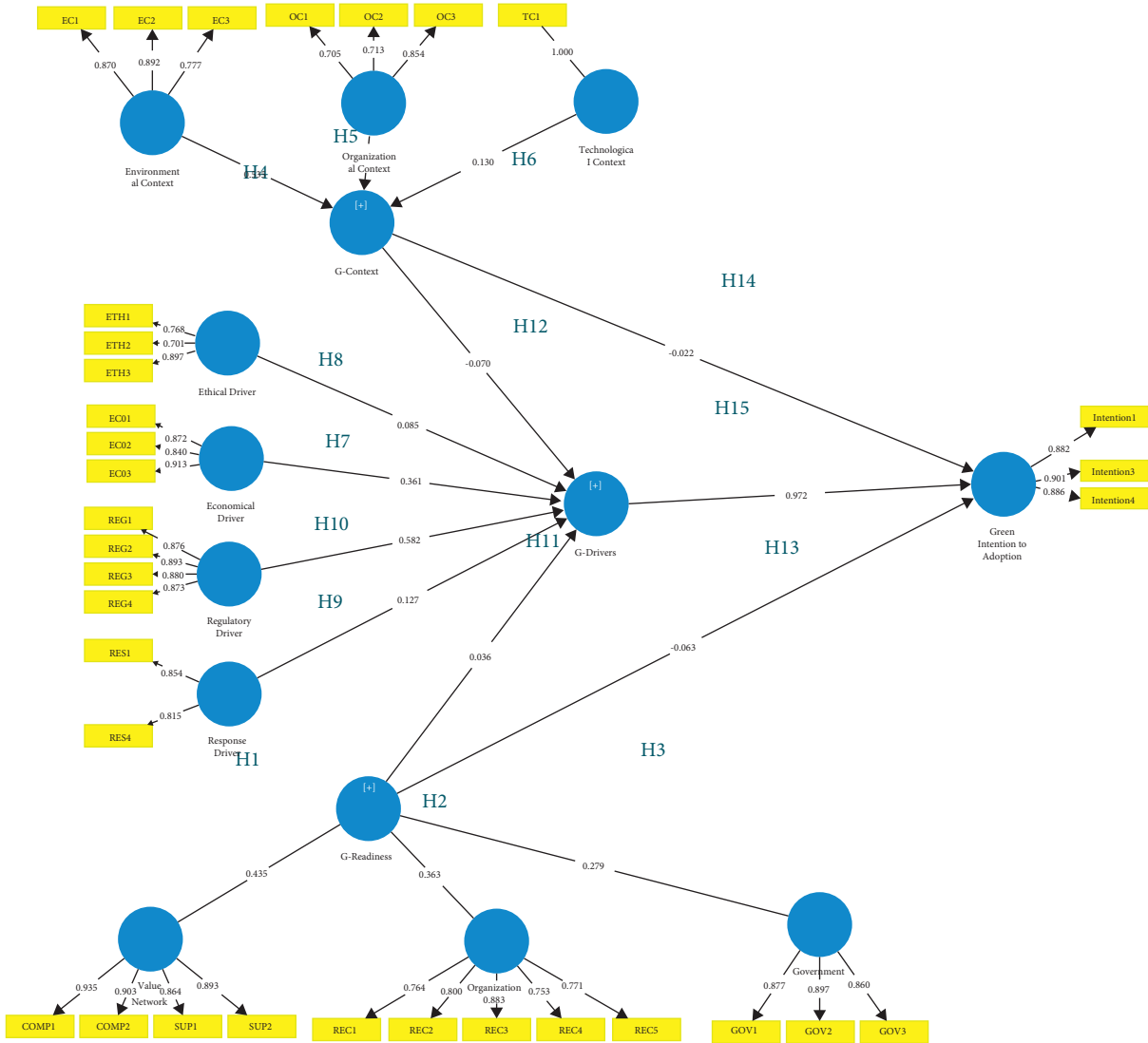


FIGURE 2: PLS outer loads.

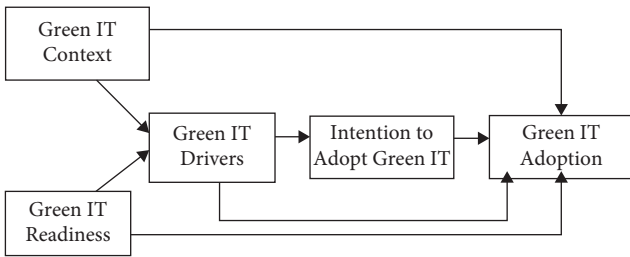


FIGURE 3: Final model.

the shared values of the software-calculated variables in the fitness evaluation of the model. GOF was found to be 0.9, confirming the fitness of the model (Table 4).

5. Managerial Insight

The important recommendation as managerial insight of the research is as follows:

- (i) The effect of green IT context on green IT adoption is significant, therefore, paying attention to the fact that green IT context will be able to create value for Iranian CIOs. Also, organizations fully understood the effect of green IT context in the green IT adoption by using green IT drivers as an intermediate factor.
- (ii) The effect of green IT readiness on green IT adoption is significant. Therefore, paying attention to green IT readiness will be able to create value for Iranian CIOs. Also, organization has fully understood the

TABLE 4: CV communality.

Coefficient	SSO	SSE	Q ²
G-context	679	287.515	0.577
G-drivers	970	483.788	0.501
G- readiness	1164	498.506	0.572
Green intention to adoption	291	112.205	0.614

effect of green IT readiness in the green IT adoption by using green IT drivers as an intermediate factor.

- (iii) The effect of green IT drivers on green IT adoption is significant. Therefore, paying attention to green IT drivers will be able to create value for Iranian CIOs. Also, organizations have fully understood the effect of green IT drivers in the green IT adoption as intermediate.
- (iv) The effect of green intention on green IT adoption is significant. Therefore, paying attention to green intention will be able to create value for Iranian CIOs. Also, organizations fully understood the effect of green intention in the green IT adoption as only intermediate.

6. Conclusion

Organizations are under continuous pressure to develop environmental sustainability improvement innovations. The successful tackling of environmental problems has been argued to possibly bring new competition opportunities and allow for adding value to core corporate practices. GIT is a crucial field in IT management. It is expected that organizations deal with ICT sustainability. IT sustainability has recently been of great interest to works on the environmental sustainability improvement of organizations.

The present study aimed to extract factors influencing GIT adoption through the views of CIOs. Three hypotheses were proposed. The findings demonstrated the statistical significance of the hypotheses. The relationships of the GIT context, GIT drivers, and GIT readiness on GIT adoption were explored. It was observed that the GIT context and GIT readiness had positive effects on the intention to adopt GIT solely under the presence of GIT drivers. The present work utilized GIT drivers as a mediating factor. The proposed hypotheses were confirmed at 0.99% of reliability. Therefore, the main results of effect between factors are as follows:

- (i) Path1: economical \rightarrow G-drivers = confirmed
- (ii) Path2: environmental \rightarrow G-context = confirmed
- (iii) Path 3: ethical driver \rightarrow G-drivers = confirmed
- (iv) Path 4: G-context \rightarrow G-drivers = confirmed
- (v) Path 5: G-context \rightarrow green intention to adoption = rejected
- (vi) Path 6: G-drivers \rightarrow green intention to adoption = confirmed
- (vii) Path 7: G-readiness \rightarrow G-drivers = confirmed
- (viii) Path 8: G-readiness \rightarrow green intention to adoption = rejected
- (ix) Path 9: government \rightarrow G-readiness = confirmed
- (x) Path 10: organizational \rightarrow G-readiness = confirmed
- (xi) Path 11: organizational context \rightarrow G-context = confirmed
- (xii) Path 12: regulatory driver \rightarrow G-drivers = confirmed
- (xiii) Path 13: response driver \rightarrow G-drivers = confirmed
- (xiv) Path 14: technological context \rightarrow G-context = confirmed
- (xv) Path 15: value network \rightarrow G-readiness = confirmed

Considering that the determination of coefficients and the analysis of relationships between factors directly depend on the opinion of experts and if the opinion of expert's changes, the results will also change; this can be mentioned as the most important limitation of the research.

This study makes suggestions for saving energy and improving organizational GIT performance. The general and specialized training of managers is helpful in long-term organizational performance improvement. Incentives could be provided in the form of discounts and wage bonuses. The modification of organizational structure to support GIT schemes is a short-term measure for organizational performance improvement. Finally, the alternation of IT operations (e.g., configuration management and asset systems) would be a green measure.

Data Availability

The data that support the findings of this study can be obtained from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

- [1] Y. Li, Z. Zhu, Y. Guan, and Y. Kang, "Research on the structural features and influence mechanism of the green ICT transnational cooperation network," *Economic Analysis and Policy*, vol. 75, 2022.
- [2] S. Popli, R. K. Jha, and S. Jain, "A comprehensive survey on Green ICT with 5G-NB-IoT: towards sustainable planet," *Computer Networks*, vol. 199, Article ID 108433, 2021.
- [3] B. Kahouli, B. Hamdi, A. Nafla, and N. Chabaane, "Investigating the relationship between ICT, green energy, total factor productivity, and ecological footprint: Empirical evidence from Saudi Arabia," *Energy Strategy Reviews*, vol. 42, Article ID 100871, 2022.
- [4] K. Lian, R. Eric, A. Karl, P. Jari, and J. P. Georges, "Education in green ICT and control of smart systems: A first hand experience from the International PERCCOM masters programme," *IFAC-PapersOnLine*, vol. 52, no. 9, pp. 1–8, 2019.
- [5] D. Esty and A. Winston, *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage*, John Wiley & Sons, New Jersey, NY, USA, 2009.
- [6] J. Webster and L. McShane, "An agenda for "Green" information technology and systems research," *Information and Organization*, vol. 21, no. 1, pp. 17–40, 2011.
- [7] F. Z. Hanne, "GREEN-IT: why developing countries should care?" *IJCSI International Journal of Computer Science Issues*, vol. 8, no. 4, pp. 1694–2081, 2011.
- [8] A. Molla, "Organizational motivations for Green IT: exploring Green IT matrix and motivation models,"

- International Journal of e-Business Management*, vol. 3, no. 2, pp. 3–23, 2009.
- [9] Y. H. Shim, K. Y. Kim, J. Y. Cho, J. K. Park, and B. J. Lee, “Strategic priority of green ICT policy in Korea: applying analytic hierarchy process,” *World Academy of Science, Engineering and Technology*, vol. 58, pp. 16–20, 2009.
- [10] C. Boughton, “What is a professional anyway?” *AUSTRAL-ASIAN JOURNAL OF INFORMATION SYSTEMS*, vol. 16, no. 1, pp. 149–163, 2009.
- [11] V. Cooper and A. Molla, “Conceptualizing green IT organizational learning (GITOL),” *Green IT Working Paper series*, vol. 1, no. No. 3, pp. 1–12, 2010.
- [12] J. Zhang and X. J. Liang, “Promoting green ICT in China: a framework based on innovation system approaches,” *Telecommunications Policy*, vol. 36, no. 10-11, pp. 997–1013, 2012.
- [13] Gartner estimates ICT industry accounts for 2 per cent of global CO2 Emissions. <http://www.gartner.com/newsroom/id/503867>.
- [14] V. A. Mangal, “Sustainability-is it for the CIO? Journal Issue,” *Electronic Green Journal*, vol. 1, p. 29, 2009.
- [15] A. P. Chobar, M. A. Adibi, and A. Kazemi, “Multi-objective Hub-Spoke Network Design of Perishable Tourism Products Using Combination Machine Learning and Meta-Heuristic Algorithms,” *Environment, Development and Sustainability*, pp. 1–28, 2022.
- [16] R. Sohrabi, K. Pouri, M. Sabk Ara, S. M. Davoodi, E. Afzoon, and A. Pourghader Chobar, “Applying sustainable development to economic challenges of small and medium enterprises after implementation of targeted subsidies in Iran,” *Mathematical Problems in Engineering*, vol. 2021, Article ID 2270983, 2029 pages, 2021.
- [17] K.-S. Khor Ramayah Ahmad, R. Thurasamy, NH Ahmad, HA Halim, and L May-Chiun, “Bridging the Gap of Green IT/IS and Sustainable Consumption,” *Global Business Review*, vol. 16, no. 4, pp. 571–593, 2015.
- [18] A. Molla, “GITAM: A Model for the Adoption of Green IT,” in *Proceedings of the Australasian Conference on Information Systems*, pp. 658–668, June 2008, <https://aisel.aisnet.org/acis2008/>.
- [19] M. Liu, “Determinants of e-commerce development: An empirical study by firms,” in *Proceedings of the 2008 4th International Conference on Wireless Communications, Networking and Mobile Computing*, pp. 1–4, shaanxi, china, October 2008.
- [20] K. Zhu and K. L. Kraemer, “Post-adoption variations in usage and value of e-business by organizations: cross-country evidence from the retail industry,” *Information Systems Research*, vol. 16, no. 1, pp. 61–84, 2005.
- [21] M. Rahmaty, A. Daneshvar, F. Salahi, M. Ebrahimi, and A. P. Chobar, “Customer churn modeling via the grey wolf optimizer and ensemble neural networks,” *Discrete Dynamics in Nature and Society*, vol. 2022, pp. 1–12, 2022.
- [22] Olson, “Creating an enterprise-level “green” strategy,” *The Journal of Business Strategy*, vol. 29, no. 2, pp. 22–30, 2008.
- [23] L. K. Mathur and I. Mathur, “An analysis of the wealth effects of green marketing strategies,” *Journal of Business Research*, vol. 50, no. 2, pp. 193–200, 2000.
- [24] I. K. Ofori, D. B. Osei, and I. P. Alagidede, “Inclusive growth in Sub-Saharan Africa: exploring the interaction between ICT diffusion, and financial development,” *Telecommunications Policy*, vol. 46, no. 7, Article ID 102315, 2022.
- [25] P. Evangelista and J. Hallikas, “Exploring the influence of ICT on sustainability in supply management: evidence and directions for research,” *Cleaner Logistics and Supply Chain*, vol. 4, Article ID 100051, 2022.
- [26] X. Yang, Y. Li, and C. H. Tan, “Drivers for green IT in organizations: multiple case studies in China and Singapore,” in *Pacific Asia Conference on Information Systems (PACIS)*, p. 91, 2013.
- [27] C. F. Lei and E. W. T. Ngai, “Green Information Technologies Adoption: A Managerial Perspective,” in *Pacific Asia Conference on Information Systems (PACIS)*, p. 274, 2013.
- [28] C. F. Lei and E. W. T. Ngai, “A research agenda on managerial intention to green IT adoption: from norm activation perspective,” in *Pacific Asia Conference on Information Systems (PACIS)*, p. 242, 2014, June.
- [29] Q. Deng and S. Ji, “Organizational green IT adoption: concept and evidence,” *Sustainability*, vol. 7, no. 12, Article ID 16755, 2015.
- [30] A. Molla and A. Abareshi, “Organizational green motivations for information technology: empirical study,” *Journal of Computer Information Systems*, vol. 52, no. 3, pp. 92–102, 2012.
- [31] S. Thomson and J. P. van Belle, “Antecedents of green IT adoption in South African higher education institutions,” *Electronic Journal of Information Systems Evaluation*, vol. 18, no. 2, pp. 172–186, 2015.
- [32] S. Dezdar, “Green information technology adoption: influencing factors and extension of theory of planned behavior,” *Social Responsibility Journal*, vol. 13, no. 2, pp. 292–306, 2017.
- [33] R. L. Mitchell, “Green by default, computer world,” 2008, http://www.computerworld.com/pdfs/LFG_green_IT_2008.pdf.
- [34] C. Petzer, C. McGibbon, and I. Brown, “Adoption of green IS in South Africa,” in *Proceedings of the South African Institute of Computer Scientists and Information Technologists Conference on Knowledge Innovation and Leadership in a Diverse Multidisciplinary Environment SAICSIT*, p. 330, Association for Computing Machinery, New York, NY, USA, October 2011.
- [35] S. Murugesan, “Harnessing green IT: principles and practices,” *IT Professional*, vol. 10, no. 1, pp. 24–33, 2008.
- [36] S. Murugesan and G. Gangadharan, *Harnessing green IT: Principles and Practices*, John Wiley & Sons, New York, NY, USA, 2012.
- [37] C. Mines and E. Davis, “Topic overview: green IT. forrester research,” 2007.
- [38] S. Sen, C. B. Bhattacharya, and D. Korschun, “The role of corporate social responsibility in strengthening multiple stakeholder relationships: A field experiment,” *Journal of the Academy of Marketing science*, vol. 34, no. 2, pp. 158–166, 2006.
- [39] A. Pourghader Chobar, M. A. Adibi, and A. Kazemi, “A novel multi-objective model for hub location problem considering dynamic demand and environmental issues,” *Journal of industrial engineering and management studies*, vol. 8, no. 1, pp. 1–31, 2021.
- [40] B. Unhelkar, *Handbook of Research on Green ICT: Technology, Business, and Social Perspectives*, IGI Global, Hershey, PA, USA, 2011.
- [41] A. Molla and A. Abareshi, “Green IT adoption: a motivational perspective,” in *Proceedings of the 15th Pacific Asia Conference on Information Systems (PACIS)*, pp. 1–14, DBLP, Queensland, Australia, January 2011.

- [42] K. K. Kuan, Y. Zhong, and P. Y. K. Chau, "Informational and normative social influence in group-buying: Evidence from self-reported and EEG data," *Journal of Management Information Systems*, vol. 30, no. 4, pp. 151–178, 2014.
- [43] A. Molla and P. S. Licker, "eCommerce adoption in developing countries: a model and instrument," *Information & Management*, vol. 42, no. 6, pp. 877–899, 2005.
- [44] S. Nunn, "Green IT: beyond the data centre how IT can contribute to the environmental agenda across and beyond the business, Accenture, 1- 7. Olson, E.G (2008) creating an enterprise-level "green" strategy," *Journal of Business Strategy*, vol. 29, no. 2, pp. 22–30, 2007.
- [45] P. J. DiMaggio and W. W. Powell, "The iron cage revisited: institutional isomorphism and collective rationality in organizational fields," *American Sociological Review*, vol. 48, no. 2, pp. 147–160, 1983.
- [46] J. F. Hair, C. M. Ringle, and M. Sarstedt, "PLS-SEM: indeed a silver bullet," *Journal of Marketing Theory and Practice*, vol. 19, no. 2, pp. 139–152, 2011.
- [47] M. Tenenhaus, V. E. Vinzi, Y. M. Chatelin, and C. Lauro, "PLS Path Modeling," *Computational Statistics & Data Analysis*, vol. 48, 2005.
- [48] J. S. Hulland, "Use of partial least squares (PLS) in strategic management research: a review of four recent studies," *Strategic Management Journal*, vol. 20, no. 2, pp. 195–204, 1999.
- [49] K. Ah-Lian, R. Eric, A. Karl, P. Jari, and J. P. Georges, "Education in green ICT and control of smart systems: a first hand experience from the International PERCCOM masters programme," *IFAC-PapersOnLine*, vol. 52, no. 9, pp. 1–8, 2019.
- [50] B. Hamdi, "Investigating the Relationship between ICT, Green Energy, Total Factor Productivity, and Ecological Footprint: Empirical Evidence from Saudi Arabia," *Energy Strategy Reviews*, vol. 42, 2022.
- [51] T. a. Jenkin, J. Webster, and L. McShane, "An agenda for "Green" information technology and systems research," *Information and Organization*, vol. 21, no. 1, pp. 17–40, 2011.
- [52] A. Molla and V. Cooper, "Green IT Readiness: a Framework and preliminary proof of concept," *Australasian journal of information systems*, vol. 16, no. 2, pp. 5–23, 2010.
- [53] A. Molla, "E-Readiness to G-Readiness: Developing a green Information Technology Readiness Framework," in *Proceedings of the 19th Australasian Conference on Information Systems*, pp. 669–678, New Zealand, Oceania, December 2008.
- [54] A. Molla, A. Abareshi, and V. Cooper, "Green IT beliefs and pro-environmental IT practices among IT professionals," *Information Technology & People*, vol. 27, no. 2, pp. 129–154, 2014.
- [55] T. Oliveira and M. F. Martins, "Understanding e-business adoption across industries in European countries," *Industrial Management & Data Systems*, vol. 110, no. 9, pp. 1337–1354, 2010.