# GREEN INFORMATION TECHNOLOGY AND ENVIRONMENTAL PERFORMANCE OF THE BANKS

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## Abstract

Information technology (IT) moves at a fast rate of utilizing modern electrical equipment. Thus, all the sectors of the world economy do face challenges to deal with the environmental problems and their impacts on the work environment and green information technology (GIT) become important to play its role in an efficient and environmentally friendly manner (McCabe, 2009). In Sri Lanka, banks recently shift towards green IT (GIT) practices. However, there is a gap in the literature, and empirical investigations regarding the relationships among GIT practices, environmental performances of banks (EPB) and employees' attitudes on GIT (EAG). Hence, this study aims to explore the relationship between GIT in place and EPB and to assess the possible mediating role of EAG in the relationship between GIT and EPB. The analyses reveal that GIT practices have a positive relationship to and significant impact on EPB. The study also confirms the mediating partial role of EAG in the relationship between GIT and EPB. This study especially contributes to empirically understand the same as an addition to fill the literature gap in relation to GIT, EPB, and EAG.

**Keywords:** Information Technology, Green Information Technology, Employee, Attitude, Environmental Performance, Bank

## 1. INTRODUCTION

Information technology (IT) do steadily improve at a fast rate with modernized electrical and electronic equipment. The IT concerns affect social patterns around the world and influence numerous distinctive patterns of human life in communication among the people, especially in the working environment (Tomlinson, 2010). Nowadays in economic sectors, technical utilization is exceptionally critical and of high level; and there are environmental impacts in using technological equipment. Eren (1999) shows that the way of using technology is one of the main causes of environmental issues, and does result in e-waste and emitting of greenhouse warming. Therefore, economic sectors must regulate their operational efficiencies in view of minimizing the negative impacts on the natural environment. In this context, it is understood that the financial institutions need to play a vital role in their environmental performance, thus implicating the *Central Bank of*

*Sri Lanka* (CBSL, 2018) to introduce technology-based products and services in financial institutions.

According to the Government Information Center of Sri Lanka (2013), the e-waste materials are transferred from developed nations to developing nations, thus resulting in insufficient capacity for institutional management in relation to the environment. Unfortunately, in Sri Lanka, a lack of government commitment and procedures has resulted in issues of managing electronic wastes (Mallawarachchi & Karunasena, 2012).

However, green information technology (GIT) is a recently emerging area of study, when the U.S. Environmental Protection Agency launched the energy star concept (Rouse, 2013)[1]. GIT especially refers to the study and practice of using computers and IT assets in an efficient and environmentally friendly way (McCabe, 2009). According to Murugesan (2008), GIT is environmentally sound of IT and focuses on four (4) main areas: designing, manufacturing, using and disposing to minimize the negative environmental impacts. This practice can lead to effective and efficient use of technological equipment and systems. O'Neill (2010) shows GIT as a strategy to reduce the carbon footprint of an organization's computing operations and is merely about reducing industry-based environmental impacts.

Many strategies have been proposed to ensure environmental performance. One important issue is reducing paper usage, since the paper is a product using natural resources, especially using wood mash that leads to deforestation. Also, one of the highly cost-effective technological tools to ensure environmental performance is called virtualization that refers to the usage of GIT to attain energy-efficient data centers by introducing diverse arrangements, such as using energy-efficient computers, networks, and server consolidation technology (Uddin, Rahman, & Memon, 2012). Through virtualization technology, cloud-computing uses cloud information centers to offer an effective computer environment. The cloud-computing system refers to dynamic and high computing capacity and capability without requiring extra computing assets (Radu, 2017).

As organisations tend to minimize organizational impacts on the environment and they accordingly implement GIT towards their sustainability performances, it is important to explore whether every organizational performance in relation to the environment is successful and how employees' attitudes become significant in transforming GIT into organizational performances. This study primarily aims to investigate in the same context in relation to the banking sector of Sri Lanka. Notably, in Sri Lanka, GIT is still in its initial stage and the GIT-based transformation takes place gradually in the industry as a continuous process.

Haas and Popov (2018), propose that banks may be less suited to decreasing industrial pollution than stock markets since banks can delay funding green technologies as well as that they may fear of financing modern innovations. Therefore, the investigation regarding the banking sector is very significant rather than investigating other financial industries. Notably, people's willingness is essential to adjust in existing attitudes towards organizational current systems in place (Mazuru, Mashavira, & Chidoko 2013); and this study, therefore, focuses on understanding the relationships among green information technology (GIT), employees' attitudes on GIT (EAG), and environmental performance of banks (EPB).

Apparently, there is also a gap in empirical studies in Sri Lanka regarding GIT adoption, in relation to GIT and EPB, and therefore, the study investigates with the selected banks in Sri Lanka relatively. The results of this study indicate that GIT has a positively linear statistical relationship to EPB with significant impacts. The study also confirms the mediating partial role of EAG in the relationship between GIT and EPB. This study especially contributes to understanding empirically the same as an addition to filling the literature gap in relation to GIT, EPB, and EAG.

To frame out the findings of this study, the rest of this paper is organized as follows: literature review and conceptualization in Section 2, methodology in Section 3, results in Section 4, discussion in Section 5, and conclusion in Section 6.

## 2. LITERATURE REVIEW AND CONCEPTUALIZATION

A set of computer programs and equipment is the core banking system used as the GIT practice to support a bank's most common transactions, such as debit and credit adjustments for standing orders, deposits and withdrawals, opening new accounts, calculating interest, keeping up-to-date records for all the bank's transactions, etc. (Rouse, 2013). The real-time transaction processing includes a continual process of inputting and outputting information with timeliness to save energy (Walker, 2013). Also, reusing e-waste and hardware is considered as a method of recovering material/parts from old devices to use in new items. These techniques can create a method for guaranteed environmental performance.

It is notable that organizations are still in the early stages of adopting GIT (Jenkin, McShane, & Webster, 2011), especially in developing nations like Sri Lanka. In this context, the employees are affected by the organizational acceptance or rejection of implementing GIT applications and therefore, the GIT has impacts on attitudes of employees. When employees understand that their job performance can be enhanced with a particular system in place, respective organisations should consider it one of the main reasons for their adoption of GIT (Davis, 1989), and accordingly, organizational motivation is important for improving employees' attitudes towards GIT and environmental performance (Akman & Mishra, 2015).

Mazuru et al. (2013) highlight the relative differences of using GIT in managerial levels of Zimbabwe banks: about 3% at branch managerial level, 75% at the executive level, and 95% at technical IT managers. However, the awareness can be of great at all management levels to adopt GIT. As people's willingness is essential to adjust in existing attitudes within the organizational current systems, this study focuses on understanding the relationship between GIT, EAG, and EPB.

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[1] Green information technology (GIT) inherently implies "GIT practices" too throughout this paper.

However, the annual report of the CBSL (2019) indicates that Sri Lanka will lose about 1.2% of annual gross domestic product (GDP) by 2050 if proper measures will not be taken to address climatic changes. As a result, the CBSL sets out plans to provide guidance and support to financial institutions. These substantiate the necessity of implementing GIT in the banking sector of Sri Lanka.

## 2.1. Organizational information technology and performance

Currently, the role of IT has become more important in strengthening an entity's competitiveness in its industry; and IT has a positive influence on improving the firm's earnings, especially in the banking sector (Lee, Choi, Lee, Min, & Lee, 2016). According to Appiahene, Missah, and Najim (2019), IT has a significant impact on the overall performance of banks that implies about 78.82% of banks are efficient in their entire operations. However, IT adaptation becomes effective only by employing highly qualified people who have effectively used the new technology and systems in place. In this context, the banks have realised the necessity of employee training to improve the skills of employees for the effective use of IT equipment (Abbas, Muzaffar, Mahmood, Ramzan, & Rizvi, 2014). However, as banking is a significant sector of an economy, Sri Lankan banks started introducing IT systems and technology-based products and service facilities, extensively with a centralized system, since 2018.

## 2.2. Concept of GIT

In business terms, *green* can be referred to as something additional but related to the natural environment. Term GIT is used by many of the industries, to reshape IT into environmentally friendly forms. According to Edgell, Meister, and Stamp (2008) and Murugesan (2008), GIT is a broad range of measures directed to reduce the environmental impacts of IT usage. In other terms, GIT is the organizational ability to deploy environment sustainable criteria of IT infrastructure life cycle (Zoysa & Wijayanayake, 2013), since GIT is the first step for all sustainability objectives (Ozturk et al., 2011).

As a recent development, online practices have been emerging in the banking sector, and the paperless banking system evolves with environmentally friendly operational practices, thus resulting in more productivity and user-friendly service transactions. Purchasing energy-efficient IT equipment is important to ensure the minimizing amount of carbon pollution in the atmosphere (the United States Environmental Protection Agency – Energy Star, 2012). Cloud provides a boost in the capacity of handling data, and cloud computing provides firms the ability to function with cost-effectiveness and efficiency. Cloud can be of great help for the organizational systems and operations in many areas, such as customer relationship management (CRM) and enterprise resource planning (ERP). However, cloud computing is based on the virtual environment, and therefore, industries operate with reduced physical infrastructure, energy

consumption, and carbon footprints (Kawatra & Kumar, 2014).

Gradual technological improvement and adoption make people consume more power and energy and this necessitated the establishment of data centres. Isberto (2018) argues that data centres become a source of risks to the environment since they release more heat. Therefore, cooling systems have been installed in the data centres. Implementing technological solutions now creates a virtual environment that runs more than one operating system on a single computer with efficiency (Waldman, 2014).

According to Lou, Benedicto, and Buenviaje (2016), the core banking system is a strategy used by banks and its implementation leads to automation in banking, thus making bank employees work in a simple, easy, accurate, and fast manner. Currently, most industries and sectors have focused on efficient energy consumption by networking as a mechanism for GIT. In this context, the transaction processing in GIT practices of banks is of two (2) types: a) batch processing system and b) real-time processing system. It is associated with the general banking transactions for handling the deposits and withdrawals, cashing of cheques, ATM and online banking functions, and other banking processes (Amin, Alauddin, & Azad, 2012).

United Nations Environment Program (UNU, 2010) has predicted that e-waste generation from old computers would rise by 500% and that from the discarded mobile phones would be about 18 times higher, by 2020 compared to 2007. Therefore, E-waste requires special handling and recycling systems to diminish environmental pollution and hazardous effects on human health. This resulted in the formulation of many recycling techniques in support of GIT and the environmental performances of organisations[2].

Interestingly, Kamaru (2015) explores that commercial banks adopt ten identical, but inter-related aspects towards their successful environmental performances. They are namely: a) adoption of paperless banking, b) purchase of energy-efficient computers, c) establishment of a green data center, d) use of cloud computing, e) embracing virtualization, f) energy-efficient networking, g) adoption of server consolidation technology, h) use of core banking system, i) recycling of electronic waste, and j) use of real-time transaction processing system. These identical aspects are conceptualized in this paper to measure the adoption of GIT in the banking sector.

## 2.3. Environmental performance

Environmental performance can be measured by the environmental management of an organisation for not damaging the natural environment. In the current context, an effective management of environment can lead a firm to achieve a competitive advantage (Abdelbasir, El-Sheltawy, & Abdo, 2018). The environmental performance can therefore be defined as the outcomes of an organisation that have no damage to the natural environment as the

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[2] Recycling – reworking of the wasted materials to perform the original function or use for other different purposes and it gives an alternative benefit from waste and save energy consumptions (Abdelbasir et al., 2018).

results of organisational activities in using land and other resources and releasing the pollutants (air, water, gas, etc.) in nature (Tyteca, 1996; Schultze & Trommer, 2011).

As many organizations pay attention to environmental performance, they adopt GIT practices (with computer systems and operating data centers) to reduce the power consumption and cost-effective outcomes (Ozturk et al., 2011). IQAir (2019) reveals that first ranked most polluted 50 cities are in Asia; and among them, the cities in India (26) and China (14) dominate[3]. This validate why the organisations in countries like Sri Lanka (in Asia) need to pay attention to environmental performance. In the world scenario, with the environmental protection acts in place, targeting for environmental performance can generally lead to increase market share, satisfied customers, reduced wastage, effective use of energy (power, fuels, and other related), increased human productivity and morale, and less exposure to regulatory compliance risk. Accordingly, this study conceptualises the environmental performance of an entity with respect to: cost-effectiveness, using efficient materials and equipment, waste management and recycling, power usage, radiation effect (if any), and nature of IT in place to enhance environmentally friendly concern.

### 2.4. Employees' attitudes on GIT practices

Davis (1989) presented the "*technology acceptance model (TAM)*" to explain how organisations adopt GIT to assist the environmental performance in consideration of employees' behaviours in their job. The TAM uses key sets of constructs in relation to using GIT, such as:
- perceived usefulness (PU) and perceived ease of use (PEU) on attitude towards use (ATU, and in this study EAG);
- behavioral intention to use (BIU);
- actual usage (AU).

PU refers to the degree of usefulness to employees' job performance by using a specific system. PEU refers to the level of users' expectations about automated (no effort) system. PU and PEU are the systems devised for employees' easy use/application that provide information on EAG; EAG leads employees to shape their behaviour (BIU) to use the system; and eventually, actual usage (AU) of the system is the resultant of employees' behavioural intentions (Mishra, Yazici, & Mishra, 2012). However, in the environmental context, Davis (1989) indicates that employees find convenience with more automation and easy application of systems to transform their behaviour into the successful environmental performances of the respective organisations.

As the behaviours of employees are the resultants of their attitudes, this study conceptualizes their attitudes as a deciding factor of environmental performances of organisations.

In this context, satisfaction and convenience, involvement and commitment, and career development of the employees in work are used to measure their attitudes towards GIT practices.

### 2.5. Conceptual framework

According to Akman and Mishra (2015), awareness of GIT practices influences the attitudes of IT users. The attitudes of employees mainly depend on the perceived ease of use (PEU) and perceived usefulness (PU) of GIT practices. Therefore, some organizations have used green practices as the motivating factor for improving EAG.

According to Beck and Ajzen (1991), the *theory of planned behavior* presents the motivational factors that influence employees' behaviour[4]. This theory explains how the employees' intention has affected the adoption of the GIT practices toward the environmental performance of an entity. The attitudes of employees influence their behaviors as the resultants of GIT adoption.

According to Jenkin et al. (2011), environmental performance is made up of three (3) components, namely environmental-related: a) attitudes, b) cognitions, and c) behaviors, from both the employee and organizational perspectives. As this study aims to investigate in the Sri Lanka banking sector, 1) employee's values, knowledge, understanding, and participation, 2) GIT practices, in achieving the environmental performance of banks (EPB), and 3) how all these impacts on EPB are in consideration.

Though the banking sector is generally not pollution making industry, the present banking operations have become a source of increasing the carbon footprints in the banks, due to the extensive use of energy (e.g., excess use of lighting, air conditioning, electronic and electrical equipment, and IT), a high volume of paper wastage, and the lack of green buildings. As GIT is for preventing the environmental degradation and become environmentally friendly, the banking sector in Sri Lanka has adopted and extended it in the recent decade. The banking sector has about 26 licensed commercial banks (LCBs) and 7 licensed specialized banks (LSBs) in Sri Lanka (CBSL, 2018). These are the initiating banks to adopt the GIT concept in Sri Lanka in view of transforming and enhancing employees' attitudes in job performance to reach the ends of EPB. In this context, this study critically considers the relationship of GIT to EAG and EPB, and accordingly conceptualises the framework for investigating the relationships between the variables and mediating role of EAG (Figure 1).

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[3] In the world first 50 polluted cities, other Asian nations account polluted cities: Pakistan – 6, Indonesia – 2, Bangladesh – 1, and Mongolia – 1 (IQAir, 2019).

[4] Theory of planned behaviour (TPB) – this is a theory proposed by Icek Ajzen (1985) and explained to link one's beliefs and behaviour. The theory indicates that intention toward attitude, subject norms, and perceived behavioural control, together shape an individual's behavioural intentions and behaviours (Theory of planned behaviour, n.d.).

**Figure 1.** Conceptual framework
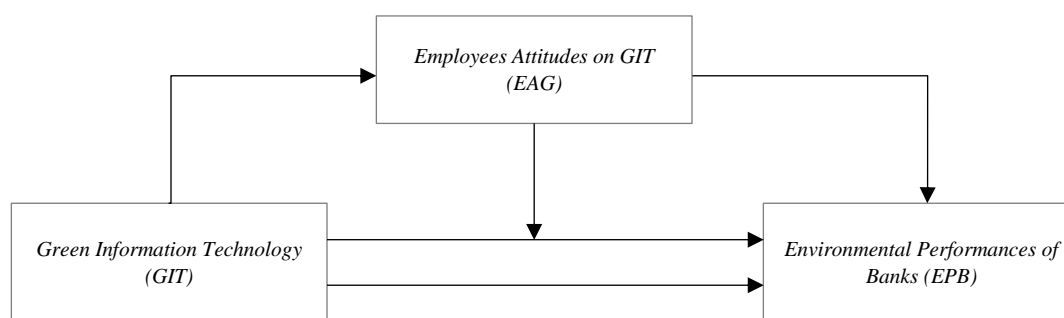


### 2.5.1. The relationship between GIT practices and EPB

As many studies emphasise that GIT practice is the environmental concern practice to reduce the negative impact on the environment (Murugesan, 2008; O'Neill, 2010; Ozturk et al., 2011). According to Ainin, Naqshbandi, and Dezdar (2016), most banks adopt GIT to contribute to environmental protection. The intensity of adopting GIT has a positive association with the EPB. GIT generally with telecommuting and video conferencing tools reduces the costs of entities. Gholami, Sulaiman, Ramayah, and Molla (2013) indicate that from the senior managers' perspective, the relationship between GIT and environmental performances of organisations has a positive relationship. They find a strong positive significant correlation between improved environmental management and adoption of GIT. Supportively, Kamaru (2015) also endorses a significant relationship between GIT practices and environmental management. Therefore, the study investigates the hypothesis:

*H1: There is a positive relationship between GIT and EPB.*

### 2.5.2. The relationship between GIT practices and EAG

Mago (2016) investigates the relationship between GIT and employees' intentions to use GIT, by using the GIT Adoption Model (GITAM) and three influencing factors: GIT context, GIT readiness, and GIT drivers. The study attempts to confirm whether these factors affect the employees' intentions to adopt GIT and finds that there is a positive relationship between GIT practices and employee intention to adopt GIT. Further, the study reveals that business managers have shown higher intensity and personality traits by using GIT. According to Ainin et al. (2016), business managers have high concern over future consequences and shown positive behaviours to adopt GIT with better attitudes. Therefore, this study relatively examines the hypothesis:

*H2: There is a positive relationship between GIT and EAG.*

### 2.5.3. The relationship between EAG and EPB

Mithas, Khuntia, and Roy (2010) indicate that top management can influence the employees to implement new practices and behaviors by using senior managers' occupational powers and can facilitate it with providing motivation to the employees. The middle management can reinforce such decisions of the top management. Thus, studies find that the commitment of senior management has a significant positive relationship to environmental performance. According to Leonard-Barton and Deschamps (1988), all subordinates do not equally perceive managerial influence. This implies that some or more of the subordinates perceive such managerial influence at least equally. Also, the top management can influence the employees' efforts dedicated to managing GIT adoption. Thus, the study evaluates the hypothesis:

*H3: There is a positive relationship between EAG and EPB.*

### 2.5.4. Intervention of EAG in the relationship between GIT and EPB

Findings indicate a positive relationship between GIT and environmental performance (e.g., Kamaru, 2015). Mago's (2016) GIT Adoption Model finds a positive relationship between GIT and employee intention to adopt GIT; and Mithas et al. (2010) explore that the senior management commitment has a positive relationship with environmental performance. The Mago's (2016) model and the findings of Mithas et al. (2010) imply that employees' attitudes (EAG) as the triggers of their behaviours play a mediating role in the relationship between GIT and environmental performance. All these in consideration, with respect to the banks, this investigation strongly conceptualises the relationship between GIT and EPB that is mediated by EAG, thus examining the same with the hypothesis:

*H4: EAG mediates the relationship between GIT and EPB.*

## 3. METHODOLOGY

### 3.1. Models

This study investigates the relativity of three variables in the banking sector: EAG, GIT, and EPB. Based on the theoretical background, literature and hypotheses above, univariate analysis (to explore the levels of variables), and correlation analyses (to examine relationships between the variables), and three (3) conceptual models have been devised, as

given below, to examine the statistical significance of EAG as a mediator in the relationship between GIT and EPB, as in MacKinnon and Luecken (2011).

$$EPB_i = \alpha_j + \beta_j GIT_i + e_i \quad (1)$$

$$EAG_i = \alpha_j + \beta_j GIT_i + e_i \quad (2)$$

$$EPB_i = \alpha_j + \beta_j GIT_j + \gamma_j EAG_i + e_i \quad (3)$$

Where,
$EPB$ = environmental performance of banks;
$GIT$ = green information technology practices;
$EAG$ = employees' attitudes on GIT;
$\alpha_j$ = intercept estimated;
$\beta_j$ and $\gamma_j$ = coefficients estimated for variables, where $j$ = 1, 2, 3 and $i$ = 1 to sample size;
$e$ = error term.

The correlation coefficients can reveal the significant relationships between the study variables at the 5% level ($p \leq 0.05$), and the respective intercepts and/or estimated coefficients of a model must be significant at the 5% level ($p \leq 0.05$) to confirm their explanatory power to predict the dependent variables in the above regression models.

The correlative relationships between the study variables (EPB, GIT, and EAG) and the role of EAG as a mediator between GIT and EPB can be alternatively confirmed with qualitative detailed analysis. Nevertheless, the way of designing the investigation and questionnaire can pave ways for the success of such an investigation. In this context, the design of investigation and questionnaire play a crucial role to explore the contribution and relationships between or among the study variables. Indicatively, some limitations are accountable, while employing the questionnaire for such a qualitative investigation.

### 3.2. Data collection and sampling description

The data are collected through the structured and self-administrated questionnaire with: Part I – Respondent's personal information and Part II – Study measures focused on GIT practices, EAG, and EPB. The study has used the five-point Likert's scale (from 1 = strongly disagree to 5 = strongly agree) to determine the measures of the variables with the closed statements in the questionnaire.

The questionnaires had been distributed among 441 employees in the selective four (4) banks in Nuwara Eliya District, Sri Lanka. The selected banks are: Bank of Ceylon, People's Bank, Sampath Bank, and Commercial Bank. Notably, all expected respondents have not submitted the duly filled questionnaires. However, about 210 questionnaires from the employees have met the requirement of a stratified sampling technique; and information and data collected from these questionnaires are used for the study purposes. The study measures GIT (practices) with ten (10) items, 3 items instrument to measure the EAG with three (3) items, and EPB with ten (10) items. The data of study variables (GIT, EAG, and EPB) have been validated with acceptable standard alpha coefficients of a minimum of 0.70 (Table 1).

**Table 1.** The reliability test of study variables

| Variable | Cronbach's Alpha | No. of items |
|---|---|---|
| Green information technology practices (GIT) | 0.839 | 10 |
| Environmental performance of banks (EPB) | 0.857 | 10 |
| Employees' attitudes on GIT (EAG) | 0.710 | 3 |

*Source: Survey data.*

## 4. RESULTS

The profile of the sample consists of the name of the bank, designation, banking qualification, experience, gender, age, and bank ownership. About 210 employees of commercial banks selected in Nuwara Eliya District, Sri Lanka. The collection of personal information (not shown in this study) is regarded for the conformity of study data collected, with a concern of filling the missing data (if required).

### 4.1. Levels of the study variables

Statistical estimations of overall responses show that mean of all variables GIT, EAG, and EPB have (Table 2) high-level attributes ($X_{GIT}$ = 4.31, $X_{EAG}$ = 4.09, and $X_{EPB}$ = 4.08) and the respective standard deviation also shows the lowest spread of the variable measures ($SDGIT$ = 0.468, $SDEAG$ = 4.09, and $SDEPB$ = 0.652)[5].

### 4.2. Relationships of the variables

Correlation estimates indicate that the study variables (GIT, EAG, and EPB) have statistically significant linear correlation coefficients at the 1% significant level ($p \leq 0.05$). Notably, all the study variables have statistically significant linear relationships between GIT and EAG, between GIT and EPB, and between EAG and EPB with positive correlation coefficients, respectively 0.618, 0.734, and 0.706, even at the 1% level ($p < 0.001$). Since all the study variables GBP, EGB, and EPB have positive linear significant correlation to each other (Table 3), the results of correlation analyses confirm the acceptances of *H1, H2, and H3 significantly*.

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[5] The range for the levels of attributes of the variables basically considered as low level, moderate level, and high level. The statistical ranges for the attributes are determined based on the mean estimation technique for the respective variable. In this context, two main assumptions are considered. *Assumption 1: a respondent is unbiased; this unbiased nature forms a normal distribution for population with mean value of Xi = 3 in Likert's scale; and its range was estimated at the 95% (where Z = ±1.96) confidence limit with the standard deviation of the sample;* and *Assumption 2: Standard deviation of population is unknown and hence, that of sample is considered as the population parameter.*

**Table 2.** Univariate analysis

| Variable | Mean $X_i$ | SD | Range for marginal level | | Attribute level |
|---|---|---|---|---|---|
| | | | *Lowest* | *Highest* | |
| GIT | 4.31 | 0.468 | 2.996 | 3.004 | HL |
| EAG | 4.09 | 0.652 | 2.994 | 3.006 | HL |
| EPB | 4.08 | 0.504 | 2.995 | 3.005 | HL |

*Note: Where GIT = green information technology (practices); EAG = employees' attitudes on GIT; EPB = environmental performance of banks; i = respective variable; SD = standard deviation; HL = high level.*
*Source: Survey data.*

**Table 3.** Pearson correlation between green information technology (GIT), employee attitude on GIT (EAG), and environmental performance of banks (EPB)

| Variable | GIT | EAG | EPB |
|---|---|---|---|
| GIT | 1.000 | 0.618** | 0.734** |
| EAG | 0.618** | 1.000 | 0.706** |
| EPB | 0.734** | 0.706** | 1.000 |

*Note: ** Correlation is significant at the 0.01 level (2-tailed).*
*Source: Survey data.*

### 4.3. Analyses of regression models

Regression analyses are specially to confirm the mediating role of the EAG in the relationship between GIT and EPB, as proposed by MacKinnon and Luecken (2011).

#### 4.3.1. Regression of EPB on GIT

The results of the regression equation (1) reveal that *Adjusted $R^2$* = 0.536. This indicates that the independent variable *GIT* can explain about 53.6% variation of EPB, and the model requires some additional variables to explain about 46.4% variability of EPB (Table 4). Further, equation (1) becomes a better fit to explain the dependent variable *EPB* with the independent variable *GIT* (coefficient estimate $\hat{\beta}_1 = 0.790$, $p < 0.01$). However,

the model of equation (1) has made a provision for other variables too (intercept $\hat{\alpha}_1 = 0.671$, $p < 0.001$) to predict EPB, with respect to GIT.

#### 4.3.2. Regression of EAG on GIT

The regression summary of equation (2) shows that *Adjusted $R^2$* = 0.379. This indicates that about 37.9% of the variation of *EAG* can be explained by *GIT*, and the rest about 62.1% variability of EAG depends on other variables (Table 4). Also, the model of equation (2) becomes a better fit to explain the EAG with the independent variable *GIT* (coefficient estimate $\hat{\beta}_2 = 0.861$, $p < 0.01$). However, equation (2) has made an insignificant statistical provision for other variables ($\hat{\alpha}_2 = 0.376$, $p > 0.05$), thus implying a statistically significant domination role of GIT in predicting EAG.

**Table 4.** Summary of regression model results of equations 1 to 3

| Models (equations 1 to 3, respectively) | Intercept $\hat{\alpha}_j$ (t-statistic) | Coefficient estimates | | Adjusted $R^2$ | The standard error of estimates |
|---|---|---|---|---|---|
| | | $\hat{\beta}_j$ (t-statistic) | $\hat{\Upsilon}_j$ (t-statistic) | | |
| $EPB_i = \hat{\alpha}_1 + \hat{\beta}_1 GIT_i$ | 0.671** (3.051) | 0.790** (15.576) | | 0.536 | $S_{\hat{\alpha}_1} = 0.220$ $S_{\hat{\beta}_1} = 0.790$ |
| $EAG_i = \hat{\alpha}_2 + \hat{\beta}_2 GIT_i$ | 0.376 (1.140) | 0.861** (11.350) | | 0.379 | $S_{\hat{\alpha}_2} = 0.329$ $S_{\hat{\beta}_2} = 0.076$ |
| $EPB_i = \hat{\alpha}_3 + \hat{\beta}_3 GIT_j + \hat{\Upsilon}_3 EAG_i$ | 0.553** (0.005) | 0.518** (0.000) | 0.315** (0.000) | 0.638 | $S_{\hat{\alpha}_3} = 0.195$ $S_{\hat{\beta}_3} = 0.057$ $S_{\hat{\Upsilon}_3} = 0.041$ |

*Note: EPB = environmental performance of banks; GIT = green information technology; EAG = employees' attitude on GIT; $\hat{\alpha}_j$ = estimates of intercepts; $\hat{\beta}_j$ and $\hat{\Upsilon}_j$ = estimates of coefficients of the independent variables, where j = 1, 2, 3, and I = 1, 2, 3, … 210.*

#### 4.3.3. Mediating role of EAG in the relationship between GIT and EPB

Equation (3) is to have regression of EPB on GIT and EAG to confirm the significant role of EAG as a mediator. The analysis of equation (3) reveals that the independent variables *GIT* and *EAG* explain about 63.8% variability of EPB, and the model implies a need for some additional variables also to explain about 36.2% variability in EPB (Table 4). Equation (3) indicates a better fit with statistically explaining

significant variables *GIT* (coefficient estimate $\hat{\beta}_3 = 0.518$, $p < 0.01$) and *EAG* (coefficient estimate $\hat{\Upsilon}_3 = 0.315$, $p < 0.01$). The model also has a provision with significance for other variables ($\hat{\alpha}_3 = 0.553$, $p < 0.01$).

The variable *EAG* as a mediator in equation (3) can possibly be confirmed with two (2) different approaches: a) coefficient paths of independent variables, and b) Sobel test of estimating the confidence limits for the mediation effect, as suggested in MacKinnon and Luecken (2011).

*Coefficient paths of independent variables in the regression models*

The coefficient path importantly requires the listing of four (4) estimated coefficients in equations (1), (2), and (3). Accordingly, they are: $\hat{\beta}_1 = 0.790$, $\hat{\beta}_2 = 0.861$, $\hat{\beta}_3 = 0.518$, and $\hat{\gamma}_3 = 0.315$ (Figure 2).

To understand the mediating role of a variable, these estimated coefficients can be renamed with usual symbols as in MacKinnon and Luecken (2011) as shown below.

$c$ = coefficient weight of explaining variable *GIT* in equation (1) = $\hat{\beta}_1 = 0.790$;

$a$ = coefficient weight of explaining variable *GIT* in equation (2) = $\hat{\beta}_2 = 0.861$;

$c'$ = coefficient weight of explaining variable *GIT* in equation (3) = $\hat{\beta}_3 = 0.518$;

$b$ = coefficient weight of variable *EAG* as a mediator in equation (3) = $\hat{\gamma}_3 = 0.315$.

MacKinnon and Luecken (2011) indicate that the condition required for assessing the mediator role of a variable between explained (dependent) and explaining (independent) variables is: $(c - c' = ab)$. However, the total effect of explaining variable (*GIT*) on the explained variable (*EPB*) can be weighted as $(c = \hat{\beta}_1 = 0.790)$.

It is possible to decompose the total weight as a direct component $(c' = \hat{\beta}_3 = 0.518)$ and an indirect component $(ab = \hat{\beta}_2.\hat{\gamma}_3) = (0.861).(0.315) = 0.27_{(2d)}$.

This indicates that $c = (c' + ab) = 0.518 + 0.271 = 0.79_{(2d)}$.

It is to confirm that $c = \hat{\beta}_1 = 0.79_{(2d)} \rightarrow$ total effect of *GIT* on *EPB* in equation (1).

**Figure 2.** Coefficient paths of estimated coefficients
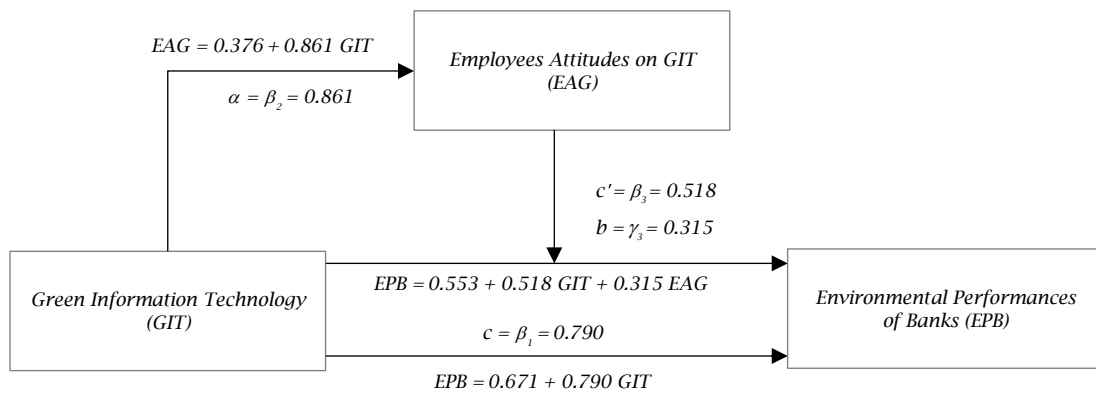


Notably, the required condition $(c - c' = ab)$ for the mediating role of a variable (now *EAG* here) between explaining (GIT) and explained (EPB) variables is met and satisfied. This confirms the mediating role of employees' attitudes on GIT (EAG) in the relationship between the independent variable *GIT* (green information technology practices) and the dependent variable *EPB* (environmental performance of banks). Thus, *H4* is statistically confirmed to endorse and validate the significant mediating role of EAG.

*Sobel test of estimating the confidence limits for the mediation effect*

Estimating confidence limits for the indirect/mediated effect $(ab)$ is also a way of confirming the mediation influence of a variable (*EAG*) between explaining (*GIT*) and explained variables (*EPB*). Accordingly, the confidence limits of the mediating effect (CLME) can be estimated as:

$$CLME = mediating\ role\ effect \pm Z_{(95\%)} * (S_{ab}) \quad (4)$$

where, $S_{ab}$ = standard error of the mediating/indirect effect = $\sqrt{S_a^2 b^2 + S_b^2 a^2}$;

And $a = \hat{\beta}_2 = 0.861$, $b = \hat{\gamma}_3 = 0.315$.

So that, the *mediating role effect* = $(ab = \hat{\beta}_2.\hat{\gamma}_3) = (0.861).(0.315) = 0.271215$.

$S_a$ = standard error of $a$ in the model of equation (2); and $S_b$ = standard error of $b$ in a model of equation (3).

Therefore, $S_a = S_{\hat{\beta}_2} = 0.076$ and $S_b = S_{\hat{\gamma}_3} = 0.041$ (Table 4).

$$S_{ab} = \sqrt{S_a^2 b^2 + S_b^2 a^2} = \sqrt{(0.076)^2.(0.315)^2 + (0.041)^2.(0.861)^2} = 0.04265 \quad (5)$$

and

$$Z_{(95\%)} = \pm 1.96 \quad (6)$$

Therefore,

$$CLME = ab \pm 1.96.(S_{ab}) = 0.271215 \pm 1.96.(0.04265) \quad (7)$$

$$UCL = 0.271215 + 0.0836 = 0.355_{(3d)} \quad (8)$$

$$UCL = 0.271215 - 0.0836 = 0.188_{(3d)} \quad (9)$$

As the value of zero (0) has not been in the range of lower (0.18761) and upper (0.35482) confidence limits, the mediated effect of employees' attitudes towards GIT (EAG) is statistically significant. Hence, the *H4: EAG mediates the relationship between GIT and EPB* is statistically accepted.

In other terms, the $Z_{(95\%)} = \pm 1.96$ can also be compared with the calculated *Z* value.

Where the calculated:

$$Z = \frac{Indirect\ Effect}{Standard\ Error\ of\ the\ Mediating\ Effect} = \frac{ab}{S_{ab}} = \frac{ab}{\sqrt{S_a^2 b^2 + S_b^2 a^2}} \qquad (10)$$

$$ab = (0.861).(0.315) = 0.271215 \qquad (11)$$

and

$$S_{ab} = \sqrt{S_a^2 b^2 + S_b^2 a^2} = 0.04265 \qquad (12)$$

Therefore, calculated:

$$Z = \frac{ab}{S_{ab}} = \frac{ab}{\sqrt{S_a^2 b^2 + S_b^2 a^2}} = \frac{0.271215}{0.04265} = 6.35863 \qquad (13)$$

As the calculated *Z* value (6.35863) falls out of the range $Z_{(95\%)} = \pm 1.96$, the mediated role effect of employees' attitudes on GIT (EAG) becomes statistically significant that confirms the hypothesis validated.

The provision of the mediating variable (EAG's) effect is:

$$= \frac{Indirect\ effect}{Total\ Effect} = \frac{(c - c' = ab)}{c} = \frac{0.790 - 0.518}{0.790} = \frac{0.272}{0.790}$$

$$= 0.3443 = 34.43\%$$

## 5. DISCUSSION

As indicated by Zoysa and Wijayanayake (2013) and Murugesan (2008), GIT becomes a crucial factor for banks to move towards their sustainability performances. As the findings of this study endorse the significant role of GIT in reducing environmental impacts, it confirms that banks have initiatives towards sustainability performances as indicated by Ozturk et al. (2011).

Notably, all variables have high-level attributes in favour of the environmental performances of banks. In this context, Kamaru's (2015) demonstration of ten (10) measures of GIT adoption in the banking sector becomes more meaningful as confirmed in this study in the Sri Lanka banking context. Also, this study endorses in line with Ozturk et al. (2011) that the adoption of GIT with computer systems and operating data centres is compatible with the reduced power consumption and cost-effective outcomes. As EAG represents high-level attributes from the bank employees' perspective, it confirms that the employees find convenience in working with more automation and easy systems applications that made them devise their behaviour towards the EPB. This is quite consistent with Davis (1989). As the study variables endorse high-level attributes, the results also consistently reveal that environmental performance is the resultant of employees' environmental-related attitudes, cognitions, and behaviors, from the perspective of employees and organization, as in Jenkin et al. (2011).

The study confirms statistically significant relationships between the variables GIT, EAG, and EPB. Banks have adopted GIT in view of reducing the negative environmental impacts and accordingly, this adoption confirms the significant relationships between GIT and EPB as extended evidence generally to the findings by Murugesan (2008), O'Neill (2010), and Ozturk et al. (2011). The positive significant relationship between GIT and EPB consistently reinforces especially the related finding by Ainin et al. (2016), Gholami et al. (2013), and Kamaru (2015).

With respect to the relationship between GIT and EAG, Ainin et al. (2016) and Mago (2016) demonstrate that employees have high concern over the future consequences and shown positive intentions and behaviours to adopt GIT with better attitudes. This study restates their finding and extensively becomes evidence of their presentation in the literature. Further, Mithas et al. (2010) endorse the positive significant relationship between the attitudes of employees and environmental performance. This study strongly reasserts their endorsement in the context of GIT adoption that there is a positive relationship between GIT and EPB. However, the argument by Leonard-Barton and Deschamps (1988) that all subordinates do not equally perceive the managerial influence has not been fully supported in this study, since both the variables have shown high-level attributes with a statistically significant relationship, even at the 1% (p < 0.01) level.

This study has initiated the investigation on the mediating role EAG, since Murugesan (2008), O'Neill (2010) and Ozturk et al. (2011) indicate that banks adopt GIT to reduce the negative environmental impacts, and Mithas et al. (2010) endorse the positive significant relationship between the attitudes of employees and environmental

performance. Accordingly, it is obvious that employees (with their attitudes and behaviours) are the mediator to link GIT and EPB. Hence, this study has devised the conceptual model and confirm the mediating effect of EAT in the relationship between GIT and environmental performances of organisations.

# 6. CONCLUSION

The study investigates the relationships of GIT, EAG, and EPB and has modelled a conceptual framework to investigate a mediating role of EAG, since the employees are the mediating instrument to link GIT and EPB. While confirming the high-level attributes of all the study variables with univariate analyses, the results of linear correlation analyses have confirmed a statistically significant relationship between each pair of the variables: between GIT and EPB, GIT and EAG, and EAG and EPB; and the related hypotheses are accepted accordingly. An extended analysis has also significantly confirmed the mediating role of EAG in the relationship between GIT and EPB, thus strengthening the direction of the investigation by accepting the respective hypothesis. The banking as an important sector of an economy, its direction towards achieving the EPB should shape the Sri Lankan economy. The findings of this study demonstrate that the banking sector aims to safeguards the environment and build an image as the good corporate citizens with improved GIT and EAG and reduced pollution.

The findings of this study, however, have some implications from the banking perspectives, especially due to the impacts of GIT and EAG on EPB. Senior management should pay high attention to install environmentally-friendly equipment while adopting GIT. The managers must also be proactive to support GIT adoption in the banks by allocating time and budget to train their people to leverage the uses of GIT. This can enable them to gain competitive advantages through GIT. Thus, this study has implications for strategists and trainers in the banking sector from the environmental protection point of view.

The banks need to make the best attention about the innovations and the strategic implementations in the sector and to strengthen with new green practices to support competitive advantage. Also, the banking sector should adopt GIT in view of improving the physical environment. However, banks cannot take the adoption of GIT in the way they want. In this context, from environmental concern, it is wise to be mandated that the Central Environmental Authority as its responsibility (especially in case of Sri Lanka) should draw, monitor, and implement required legislation for implementing GIT and related activities, and that of banks' employment governing authorities (especially the human resource departments of banks) should also monitor and regulate the essential training and practices for employees. Thus, this study has implications for respective institutional and national policymakers in view of shaping the economy by adopting GIT in banks, because green practices become an essential part in the modern banking industry for environmental protection.

In the context of Sri Lanka, this study, however, has a major limitation that Sri Lanka as a Third World country and her one of the regions (Nuwara-Eliya District) as a study area have concern over the technological systems applications in place in the respective area banks. Thus, it is strongly arguable that if the limitation is managed well in other related forthcoming studies, the findings of the study can be endorsed strongly and meaningfully.

Finally, though this study fills the gap in the literature, future studies can be devised for other possible mediating effects of a related variable in the relationship between GIT and EPB. Hence, this investigation provides a base for future studies with the application of the methodology in this paper. Also, in a broad perspective, though this study is related to the banking sector, the results of this study can give some insight into other sectors like insurance, telecom services, education, health care, tourism, etc. If those sectors have concerns over adopting GIT for achieving environmental performances, this study can be a base or an extension for further relationship studies between the variables GIT, EAG, and environmental performance. Hence, this study has implications to that extent.

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## APPENDIX. QUESTIONNAIRE OF THE STUDY

Questionnaire on Green Information Technology Practices and Environmental Performance of Banks

*Dear Sir/Madam,*
We conduct a study on *"Green Information Technology Practices and Environmental Performance of Banks".* For this purpose, we need your concern and support to complete the questionnaire below to make our investigation meaningful. We are very much grateful to you, if you can pay attention and spend your valuable time to respond this questionnaire and to return it to us sooner. We give assurance that your responded data and information will be maintained with strictly confidential and utilised only for this investigation purpose.

Thank you for your time, cooperation, and consideration.
*Survey Investigators.*

### Part I: Personal information

Please give your answer to the following questions by indicating (X) in the given spaces.

1. Name of the Bank
   1. Bank of Ceylon
   2. People's Bank
   3. Sampath Bank
   4. Commercial Bank
   *Note: Private banks coded 3 & 4 are public limited companies.*

2. Designation
   1. Manager
   2. Asst. Manager
   3. Officer
   4. Banking Asst.
   5. Banking Trainee
   6. Other

3. Banking Qualification
   1. GCE (O/L)
   2. GCE (A/L)
   3. Graduate
   4. Banking Diploma
   5. Other
   (where GCE = General Certificate of Education, O/L = Ordinary Level, A/L = Advanced Level)

4. Experience
   1. 1-2 years
   2. 3-5 years
   3. Above 5 years

5. Gender
   1. Male
   2. Female

6. Age
   1. Below 20 years
   2. 21-30 years old
   3. 31-40 years old
   4. 41-50 years
   5. Above 50 years

***Part II: Research information on green information technology practices and environmental performance of the bank***

Please indicate your level of agreement (as described from 1 to 5) with a mark (✔), in respect of each statement in the table below.

1 = Strongly Disagree      2 = Disagree      3 = Moderately Agree
4 = Agree      5 = Strongly Agree

| | DESCRIPTION OF STATEMENT FOR VARIABLES | *Degree of Agreement* | | | | |
|---|---|---|---|---|---|---|
| | | *1* | *2* | *3* | *4* | *5* |
| | **Green information technology (GIT)** | | | | | |
| 1 | My bank implements a paperless banking system and reduces paper works. | | | | | |
| 2 | My bank interested to purchase energy-efficient computers, printers, and other IT equipment. | | | | | |
| 3 | My bank decided to practice 'Cloud Computing' such as online billing, mobile banking, pay easy, online payment apps, self-banking, automation, etc. | | | | | |
| 4 | My bank is adopting Green Data Centers/energy-efficient data management. | | | | | |
| 5 | My bank has improved the efficiency and effectiveness of banking services through virtualization and digitization. | | | | | |
| 6 | My bank uses energy-efficient networks and there is high efficiency in energy utilization. | | | | | |
| 7 | My bank reduces the number of servers/computers required and adopted efficient use of computing resources such as server consolidation technology. | | | | | |
| 8 | My bank adopted the Core Banking System to a great extent. | | | | | |
| 9 | My bank recycles the electronic waste effectively. | | | | | |
| 10 | My bank uses Real-Time Transaction Systems and Real-time Transaction Processing. | | | | | |
| | **Employees' attitudes on GIT** | | | | | |
| 11 | Practicing Green IT made me satisfied with convenient in work. | | | | | |
| 12 | Practicing Green IT induces me to involve and commit in work with interest. | | | | | |
| 13 | Practicing Green IT is worth for my career development. | | | | | |
| | **Environmental performance of the banks** | | | | | |
| 14 | My bank's investment in appropriate IT has enabled the bank to reduce the cost of electricity. | | | | | |
| 15 | In my bank, less paper is used due to investment in IT. | | | | | |
| 16 | The bank has reduced electronic waste. | | | | | |
| 17 | IT has led to efficient use of energy in our bank. | | | | | |
| 18 | Reduce and recycling of IT, has reduced pressure on Environmental Performance. | | | | | |
| 19 | In overall adoption of IT by the bank has reduced environmental pollution. | | | | | |
| 20 | Recycling electronic waste has reduced the use of new materials from the environment. | | | | | |
| 21 | Use of Green IT has reduced unnecessary radiation to the environment. | | | | | |
| 22 | Green IT disposal practices have reduced damping if electronic waste to the environment. | | | | | |
| 23 | Adoption of IT improves efficiency in Environmental Performance. | | | | | |

Thank You for your valuable time and consideration to respond the questionnaire.