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Research Article

Environmental Impacts of Climate Change and the Intention to Adopt Green Information Technology

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ABSTRACT
Organisations worldwide are increasingly prioritising environmental sustainability, with Green Information Technology (Green IT) recognised as an effective approach to reducing environmental impacts and supporting sustainable organisational practices. However, empirical evidence on the determinants of Green IT adoption within Nigeria's manufacturing sector remains limited. This study developed and validated a model to explain factors influencing decision-makers' intentions to adopt Green IT in Nigeria's manufacturing industry. The model integrates the Theory of Planned Behaviour (TPB) and the Norm Activation Model (NAM) to examine behavioural and normative determinants of adoption. Hypotheses were tested using data collected through a structured questionnaire administered to decision-makers in manufacturing organisations. The data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). Nine hypotheses were supported, including seven direct effects and one moderation effects. Four of the six moderation hypotheses were not supported. The study contributes to the Green IT literature by validating an integrated behavioural model and provides practical guidance for managers, policymakers and organisations seeking to promote environmentally sustainable industrial development. The findings also highlight the importance of distinguishing direct environmental concern effects from its moderating role in explaining Green IT adoption intention.

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1.0 INTRODUCTION

The increasing severity of climate change and environmental degradation has intensified global concern for sustainable industrial development (Adiguzel & Cakir, 2024; Arabov et al., 2024; Hudu et al., 2026; Ihemeson, 2024; Magnano San Lio et al., 2023; Saleem et al., 2025; UNEP Report, 2019). In response, organisations are increasingly adopting sustainable practices to minimise environmental impacts while maintaining economic competitiveness. Sustainable Information Technology (IT) refers to technological practices that meet present organisational needs without compromising the ability of future generations to meet theirs (Chen et al., 2009; Zhang et al., 2018). Consequently, Green Information Technology (Green IT) has emerged as an important strategy for reducing energy consumption, lowering carbon emissions, and promoting environmentally sustainable business operations (Buba & Ibrahim, 2023; Scott & Watson, 2012; Chiboiwa et al., 2024).

Green IT encompasses the environmentally responsible design, use, management, and disposal of information and communication technologies (ICTs) to enhance organisational sustainability (Anthony et al., 2019; Haleem et al., 2024). In addition to reducing pollution and resource consumption, it improves organisational efficiency while delivering economic, environmental, and social benefits (Alam et al., 2024; Ali et al., 2019; Guo et al., 2023). Given the significant contribution of ICT to global carbon emissions, the adoption of Green IT has become an essential component of sustainable development.

Despite the growing international interest in Green IT, empirical evidence from Nigeria, particularly within the manufacturing sector, remains limited. Existing research has largely focused on energy efficiency and sustainability awareness, with relatively little attention devoted to the behavioural factors influencing Green IT adoption among organisational decision-makers (John et al., 2018; Okwara et al., 2020). Moreover, validated behavioural models that explain Green IT adoption in this context remain scarce, highlighting the need for further investigation.

Accordingly, this study aims to identify the factors influencing decision-makers' intentions to adopt Green IT in Nigeria's manufacturing sector and to develop a behavioural model to explain this intention. Specifically, the study seeks to: (i) identify the determinants of Green IT adoption intention; (ii) examine the relationships between these determinants and behavioural intention; and (iii) develop and validate an integrated behavioural model to support Green IT implementation in manufacturing organisations. The findings are expected to contribute to the growing body of Green IT literature while providing practical insights for decision-makers seeking to promote environmentally sustainable practices within the manufacturing sector. The remainder of the paper is organised as follows: the next section reviews the relevant literature, followed by the research methodology, data analysis, discussion of the findings, and the conclusion.

2. Previous Studies on Green IT Adoption

The relationship between Green IT and Green IS has attracted considerable attention in the literature, although their distinction remains the subject of ongoing discussion (Chen et al., 2009; Loeser, 2013; Marrone et al., 2011; Schmermbeck, 2019; Mat Nawi et al., 2024). While Green IT is widely regarded as a component of Green IS (Brooks et al., 2010; Buba & Ibrahim, 2021; Cooper & Molla, 2012; Hardin et al., 2018; Molla, 2008; Sarkis et al., 2013; Riaz et al., 2024), its primary focus is on reducing the environmental impacts associated with hardware, software, and energy consumption (McLaren et al., 2010; Tushi et al., 2014). Green IS, by comparison, applies information systems to support broader ecological sustainability initiatives (Jenkin et al., 2011; Vom et al., 2013; Goethals & Ziegelmayer, 2024; Ijaz et al., 2025). Despite these differences, the two concepts are complementary and collectively promote environmentally sustainable IT practices (Cai et al., 2013; Hardin et al., 2018; Przychodzen et al., 2018).

As environmental sustainability has become a global priority, scholarly interest in Green IT has increased considerably. Existing reviews have examined Green IT from various perspectives (Brooks et al., 2010; Jnr, 2016; Singh & Sahu, 2020); however, comparatively little attention has been given to regional, continental, and developed versus developing country contexts. A broader understanding of these perspectives is essential for supporting the effective implementation of Green IT and advancing environmental sustainability. Such knowledge also contributes to achieving the United Nations Sustainable Development Goal 13 under the 2030 Agenda.

Growing interest in sustainable technologies has also stimulated research into the factors influencing Green IT adoption. Although the body of literature has expanded, studies examining Green IT as an innovation remain relatively limited. Existing research has largely focused on adoption issues while providing comparatively less attention to the broader characteristics of Green IT innovation. To provide an overview of this body of knowledge, Appendix B summarises the theories, methodologies, data collection methods, analytical techniques, and participants reported in previous Green IT adoption studies.

3. Theoretical background and hypotheses development

The Norm Activation Model (NAM), proposed by Schwartz., (1977), explains pro-environmental behaviour through individuals' moral obligations and personal norms. The model suggests that awareness of the consequences of one's actions and the ascription of responsibility activate personal norms, which subsequently influence behavioural intentions (Gao et al., 2017; Park & Ha, 2014; Shin et al., 2018). As NAM has been widely applied to explain environmentally responsible behaviour (Han, 2015), this study incorporates its key constructs to examine the intention to adopt Green IT in the manufacturing sector.

The Theory of Planned Behaviour (TPB) explains behaviour as a function of behavioural intention, which is influenced by attitude, subjective norm, and perceived behavioural control (Harland et al., 1999). TPB has been extensively applied to predict pro-environmental behaviour across different contexts (Han et al., 2010; Papagiannakis & Lioukas, 2012; Shin et al., 2018; Sniehotta et al., 2014). Given its strong predictive capability, TPB provides an appropriate theoretical basis for examining decision-makers' intentions to adopt Green IT.

As both TPB and NAM have been widely used to explain pro-environmental behaviour, integrating the two theories provides a comprehensive framework for understanding the intention to adopt Green IT. Accordingly, this study combines the relevant constructs of both theories to develop the proposed research model and hypotheses.

3.1 Proposed Integrated Theoretical Model

Drawing on previous studies, the proposed model integrates the most relevant constructs from TPB and NAM that are applicable to Green IT adoption in the Nigerian manufacturing context. Rather than incorporating all possible determinants, the model focuses on the factors most consistently reported in the literature. Accordingly, seven constructs were selected: attitude, subjective norm, perceived behavioural control, environmental concern, personal norm, awareness of consequences, and ascription of responsibility. The proposed integrated theoretical model is presented in Figure 1.

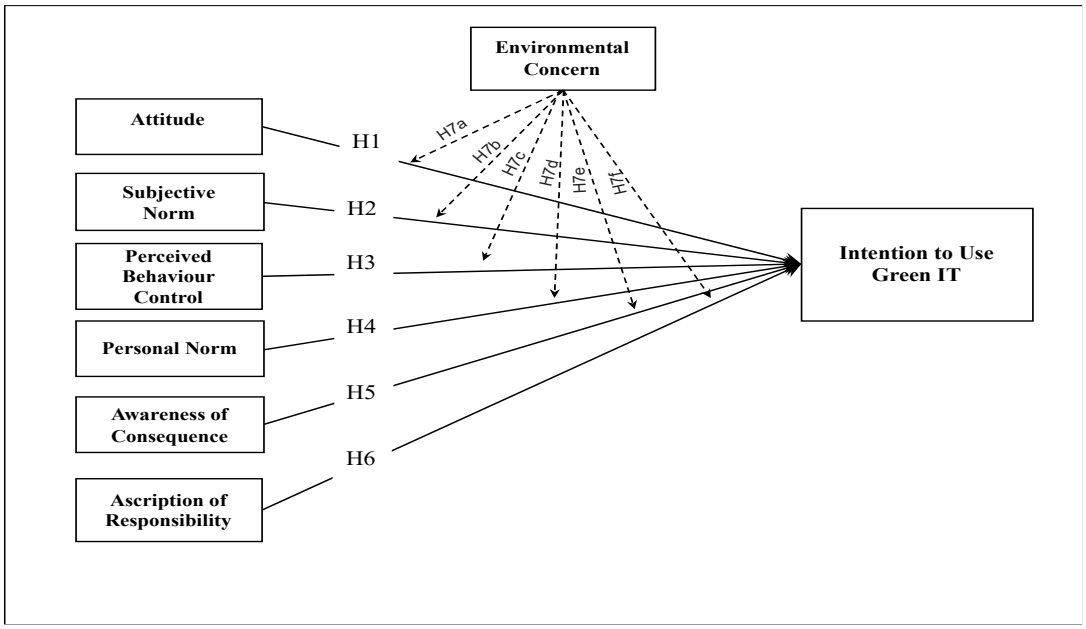


Figure 1. The Proposed Model

3.2 Research Hypotheses

The research hypotheses were developed based on the theoretical background and empirical evidence presented in the previous sections. The proposed relationships among the study constructs are presented as follows

3.2.1 Hypothesis 1: Attitude (ATT)

A positive attitude towards Green IT is expected to encourage its adoption by increasing awareness of its environmental and organisational benefits. Previous studies have shown that attitudes and moral values positively influence pro-environmental behaviour (Chen & Tung, 2014; Steg & de Groot, 2010; Zhang et al., 2013). Therefore, the following hypothesis is proposed:

H1: *Managers' attitude positively influences their intention to adopt Green IT.*

3.2.2 Hypothesis 2: Subjective Norm (SN)

Subjective norm reflects the perceived social pressure to perform a particular behaviour (Ajzen, 1991). Previous studies have demonstrated that social influence and external support positively affect individuals' intentions to adopt environmentally friendly practices (Dezdar, 2017; Juschten et al., 2019; Zhang et al., 2019). Therefore, the following hypothesis is proposed:

H2: *Subjective norm positively influences managers' intention to adopt Green IT.*

3.2.3 Hypothesis 3: Perceived Behavioural Control (PBC)

Perceived behavioural control reflects an individual's perception of the ease or difficulty of performing a behaviour (Ajzen, 1991). It is influenced by factors such as available resources, time, and perceived complexity (Buba et al., 2020; Lin & Huang, 2012; Lopes et al., 2019). Although previous findings are mixed (Zhang et al., 2019), perceived behavioural control is expected to enhance managers' intention to adopt Green IT.

H3: *Perceived behavioural control positively influences managers' intention to adopt Green IT.*

3.2.4 Hypothesis 4: Personal Norm (PN)

Personal norm reflects an individual's moral obligation to engage in pro-environmental behaviour (Schwartz & Davis, 1981). Previous research suggests that moral responsibility encourages environmentally responsible actions (Buba & Ibrahim, 2021; Harland et al., 2007). Therefore, the following hypothesis is proposed:

H4: *Personal norm positively influences managers' intention to adopt Green IT.*

3.2.5 Hypothesis 5: Awareness of Consequences (AC)

Awareness of consequences refers to an individual's recognition of the

environmental impacts of their actions (Groot & Steg, 2009). Greater awareness has been associated with stronger pro-environmental behaviour and the adoption of eco-innovations (Agag, 2019; Harland et al., 2007). Therefore, the following hypothesis is proposed:

H5: *Awareness of consequences positively influences managers' intention to adopt Green IT.*

3.2.6 Hypothesis 6: Ascription of Responsibility (AR)

Ascription of responsibility represents an individual's sense of responsibility for environmental outcomes and is a key construct of the Norm Activation Model (Harland et al., 2007). Previous studies have shown that it positively influences pro-environmental behaviour (Willuweit, 2009; Y. Zhang et al., 2013). Therefore, the following hypothesis is proposed:

H6: Ascription of responsibility positively influences managers' intention to adopt Green IT.

3.2.7 Direct and Moderating Effects of Environmental Concern (EC)

Environmental concern reflects an individual's concern for environmental protection and has been recognised as an important predictor of environmentally responsible behaviour (Chen & Tung, 2014; Lin & Huang, 2012; Sujata et al., 2019; Zhang et al., 2019; Zhao et al., 2014). In this study, EC was modelled both as a direct predictor of behavioural intention and as a moderator of the relationships between the other determinants and intention. The direct effect is tested by H7, while the six moderation effects are tested by H7a–H7f.

H7: Environmental concern positively influences behavioural intention to adopt Green IT.

H7a: Environmental concern positively moderates the relationship between attitude and behavioural intention to adopt Green IT.

H7b: Environmental concern positively moderates the relationship between subjective norm and behavioural intention to adopt Green IT.

H7c: Environmental concern positively moderates the relationship between perceived behavioural control and behavioural intention to adopt Green IT.

H7d: Environmental concern positively moderates the relationship between personal norm and behavioural intention to adopt Green IT.

H7e: Environmental concern positively moderates the relationship between awareness of consequences and behavioural intention to adopt Green IT.

H7f: Environmental concern positively moderates the relationship between ascription of responsibility and behavioural intention to adopt Green IT.

4. Methodology

This study adopted a positivist research paradigm, which emphasises the collection and analysis of objective, measurable data. The methodology comprises three stages: instrument development and validation, data collection, and data analysis.

4.1 Instrument Development and Validation

The proposed model consists of seven independent variables (ATT, SN, PBC, PN, AC, AR, and EC) and one dependent variable (behavioural intention to adopt Green IT), consistent with previous studies (Dao et al., 2011). A total of 40 measurement items were adapted from the existing literature (see Appendix C) and measured using a five-point Likert scale. The questionnaire was reviewed by two experts in technology adoption research to establish content validity, after which minor revisions were made to improve clarity and relevance. The questionnaire comprised two sections. Section A collected respondents' demographic information, while Section B measured the study constructs using validated items from previous research. The study targeted managers and decision-makers from Nigeria's manufacturing sector. For sampling, each company on the sampling frame was assigned a unique number and Microsoft Excel's RAND function was used to generate random values; the five companies with the lowest random values were selected. Four of the five selected companies granted permission for data collection. The final sample of 210 valid responses exceeds the 10-times rule for the largest number of structural paths directed at the endogenous construct (13 paths, requiring at least 130 observations), although a formal a priori power analysis

was not conducted. Printed questionnaires were distributed through face-to-face administration over a three-month period using a cross-sectional survey design (Creswell & Creswell, 2017; Levin, 2006). A total of 450 questionnaires were distributed, 240 were returned, representing a 53.3% response rate. After screening for incomplete and inconsistent responses, 210 valid questionnaires were retained for subsequent analysis.

4.2 Data Analysis

The completed questionnaires were coded, entered into Microsoft Excel, cleaned, and prepared for analysis using SmartPLS. Descriptive statistics were used to summarise the respondents' characteristics, while Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to test the proposed hypotheses. PLS-SEM was selected because it effectively handles measurement error and is well suited to analysing complex research models (Chin et al., 2003). Following the recommendations of Hair et al., (2017), the analysis was conducted in two stages: assessment of the measurement model followed by evaluation of the structural model.

5. RESULTS

5.1 Demographic analysis

Table 1 presents the demographic characteristics of the respondents. Overall, 65.7% were male and 34.3% were female. Most respondents (72.4%) were aged between 21 and 35 years, while 27.6% were above 35 years. Respondents represented different management levels and possessed varying levels of professional experience, with 60% having between 2 and 8 years of experience and 40% having more than 9 years. Educational qualifications also varied, with the majority holding a university degree (see Table 1).

5.2 Assessment of measurement model

The measurement model was assessed using indicator loadings, composite reliability (CR), average variance extracted (AVE), and discriminant validity, following the recommendations of Hair et al., (2017). Table 2 presents the convergent validity results, including the retained indicator loadings, CR and AVE. The results indicate satisfactory indicator reliability, internal consistency and convergent validity for the retained constructs. Table 3 presents the Fornell–Larcker assessment of discriminant validity, which confirms that the constructs are empirically distinct and suitable for subsequent structural model analysis.

Table 1: Demographic information of the respondents

Items	**Variable Level**	**Frequency**	**Percentage (%)**
Sex	Male	138	65.7
	Female	72	34.3
Age	21-25 years	26	12.4
	26-30 years	64	30.5
	31-35 years	62	29.5
	More than 35	58	27.6
Education	College	49	23.3
	High school	15	7.1
	University	146	69.5
Experience	Less than 2 years	39	18.6
	3-5 years	25	11.9
	6-8 years	62	29.5
	9 years and above	84	40.0
Role	Lower Manager	92	43.8
	Middle Manager	91	43.3
	Top Manager	27	12.9

Convergent validity in PLS-SEM was assessed using indicator loadings, composite reliability (CR) and average variance extracted (AVE) (Hair et al., 2017). Indicator loadings of 0.50 or above were retained in accordance with the criterion adopted for this study, with values of 0.70 or above indicating stronger indicator reliability. Composite reliability values above 0.70 indicate satisfactory internal consistency, while AVE values above 0.50 indicate adequate convergent validity (Fornell & Larcker, 1981). The results are presented in Table 2.

Table 2: Convergent validity

SN	Constructs	Indicator	Loadings	CR	AVE
1	Awareness Consequences	AC1	0.874	**0.834**	**0.623**
		AC2	0.752	-	-
		AC3	0.778	-	-
2	Ascription of Responsibility	AR1	0.839	**0.844**	**0.645**
		AR2	0.936	-	-
		AR3	0.711	-	-
		AR4	0.951	-	-
3	Green IT Attitude	ATT1	0.848	**0.853**	**0.540**
		ATT2	0.661	-	-
		ATT3	0.601	-	-
		ATT4	0.778	-	-
		ATT5	0.761	-	-
4	Environmental Concern	EC1	0.515	**0.820**	**0.539**
		EC2	0.793	-	-
		EC4	0.767	-	-
		EC5	0.821	-	-
5	Intention to Use Green IT	INT1	0.668	**0.833**	**0.557**
		INT3	0.745	-	-
		INT4	0.806	-	-
		INT5	0.759	-	-
6	Perceived Behaviour	PBC1	0.813	**0.829**	**0.505**
		PBC2	0.587	-	-
		PBC3	0.637	-	-
		PBC4	0.504	-	-
		PBC5	0.928	-	-
7	Personal Norm	PN1	0.881	**0.837**	**0.515**
		PN2	0.753	-	-
		PN3	0.788	-	-
		PN4	0.523	-	-
		PN5	0.582	-	-
8	Subjective Norms	SN2	0.715	**0.885**	**0.660**
		SN3	0.761	-	-

		SN4	0.859	-	-
		SN5	0.900	-	-

Measurement-model refinement resulted in the removal of six of the original 40 indicators: AR5, AC4, AC5, EC3, SN1 and INT2. AR5 had a loading of 0.355 and was therefore excluded. The remaining five indicators were also excluded during refinement because they did not meet the study's retained-item criteria. The final measurement model contains 34 indicators.

5.3 Assessment of the Structural Model

The structural model was assessed following the recommendations of Hair et al., (2017) by examining the coefficient of determination (R^2), path coefficients (β), and t-values obtained through bootstrapping. Figure 2 presents the structural model, while Table 7 reports the structural estimates used to evaluate the proposed hypotheses. The coefficient of determination for behavioural intention was $R^2 = 0.642$, indicating that the model explains 64.2% of the variance in behavioural intention. Path coefficients were considered statistically significant at $p < 0.05$ with corresponding t-values greater than 1.96.

Furthermore, Table 3 presents the Fornell–Larcker criterion for assessing discriminant validity. The results show that the square roots of the Average Variance Extracted (AVE) for all constructs exceeded the corresponding inter-construct correlations, confirming satisfactory discriminant validity. This indicates that the constructs are empirically distinct and that the measurement model was suitable for subsequent structural model assessment.

Table 3. Fornell-Larcker criterion

	AR	**AC**	**INT**	**EC**	**ATT**	**PBC**	**PN**	**SN**
AR	0.803							
AC	0.044	0.789						
INT	0.380	0.519	**0.746**					
EC	0.363	0.341	0.539	**0.734**				
ATT	0.314	0.367	0.608	0.295	**0.735**			
PBC	0.112	0.287	0.258	0.096	0.094	**0.711**		
PN	0.162	0.015	0.406	0.180	0.257	-0.107	**0.718**	
SN	0.166	0.244	0.370	0.159	0.308	0.182	0.126	**0.812**

Assessing discriminant validity through the examination of cross-loadings indicates that the outer loading of a specific construct in a model should be greater than that of any other construct, as illustrated in Table 4. If the cross-loadings are higher than the outer loadings of the indicators, it may indicate a potential issue with the level of discriminant validity. This criterion is perceived to be mild with regard to defining the discriminant validity for a particular study (Joe et al., 2011). In other words, it is quite possible to highlight that two or more constructs display discriminant validity.

Table 4. Cross-loadings of indicator

	AC	AR	ATT	EC	INT	PBC	PN	SN
AC1	**0.874**	0.078	0.474	0.340	0.569	0.132	0.106	0.251
AC2	**0.752**	-0.029	0.115	0.191	0.288	0.342	-0.068	0.168
AC3	**0.778**	0.020	0.137	0.246	0.272	0.337	-0.098	0.129
AR1	0.007	**0.839**	0.265	0.296	0.258	0.038	0.119	0.076
AR2	0.080	**0.936**	0.279	0.433	0.434	0.136	0.195	0.186
AR3	-0.035	**0.711**	0.115	0.137	0.219	0.095	0.194	0.086
AR4	0.023	**0.951**	0.260	0.367	0.334	0.060	0.109	0.154
ATT1	0.193	0.166	**0.848**	0.116	0.382	0.049	0.129	0.219
ATT2	0.109	0.209	**0.661**	0.165	0.299	-0.022	0.257	0.282
ATT3	0.057	0.214	**0.601**	0.161	0.229	-0.052	0.319	0.032
ATT4	0.531	0.307	**0.778**	0.392	0.688	0.241	0.183	0.325
ATT5	0.156	0.209	**0.761**	0.094	0.370	-0.073	0.146	0.152
EC1	0.209	0.019	0.019	**0.515**	0.061	0.100	-0.031	0.090
EC2	0.357	0.370	0.290	**0.793**	0.579	0.182	0.182	0.165
EC4	0.186	0.195	0.145	**0.767**	0.250	-0.002	0.078	0.094
EC5	0.183	0.250	0.230	**0.821**	0.348	-0.052	0.147	0.085
INT1	0.306	0.109	0.348	0.171	**0.668**	0.106	0.578	0.365
INT3	0.334	0.218	0.391	0.424	**0.745**	0.092	0.294	0.278
INT4	0.593	0.223	0.628	0.413	**0.806**	0.296	0.184	0.340
INT5	0.273	0.573	0.407	0.582	**0.759**	0.239	0.211	0.128
PBC1	0.359	0.045	0.084	0.174	0.225	**0.813**	-0.088	0.155
PBC2	0.081	-0.011	0.010	0.001	0.088	**0.587**	0.019	0.103
PBC3	-0.009	0.027	-0.075	-0.030	0.051	**0.637**	-0.095	0.128
PBC4	-0.047	-0.067	-0.096	-0.077	0.015	**0.504**	-0.004	0.101
PBC5	0.237	0.181	0.129	0.053	0.274	**0.928**	-0.122	0.161
PN1	0.085	0.140	0.275	0.171	0.466	0.000	**0.881**	0.245
PN2	-0.021	0.152	0.116	0.095	0.193	-0.161	**0.753**	0.006
PN3	-0.035	0.052	0.127	0.080	0.275	-0.069	**0.788**	0.067
PN4	-0.032	0.180	0.228	0.160	0.197	-0.223	**0.523**	-0.026
PN5	-0.039	0.073	0.107	0.154	0.127	-0.060	**0.582**	-0.075
SN2	0.120	0.062	0.179	-0.022	0.127	0.073	0.068	**0.715**
SN3	0.087	0.272	0.202	0.195	0.212	0.141	0.026	**0.761**
SN4	0.086	0.202	0.167	0.152	0.256	0.154	0.128	**0.859**
SN5	0.355	0.061	0.362	0.139	0.443	0.180	0.141	**0.900**

After determining Q^2, the next step was to assess f^2 and Q^2. These statistics indicate the contribution and predictive relevance of the exogenous constructs to the endogenous construct. The f^2 effect size represents the change in R^2 when an exogenous construct is removed from the model. In accordance with the thresholds adopted in this study, f^2 values of 0.02, 0.15 and 0.35 represent small, medium and large effects, respectively (Streukens et al., 2010). The effect sizes and predictive relevance results are presented in Tables 5 and 6.

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}} \quad \text{(5.1)}$$

$$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}} \quad \text{(5.2)}$$

Table 5. Effect sizes ($_f^2$)

Path	f^2	Effect Size
ATT -> IN	**0.189**	Medium
SN -> IN	0.025	Small
PBC -> IN	0.053	Small
PN -> IN	**0.168**	Medium
AC -> IN	0.143	Small
AR -> IN	0.040	Small
EC -> INT	0.133	Small

The result of the q2 is presented in Table 6. Revealed that Green Attitude and Personal Norms, Awareness of Consequences, Environmental Concern, subjective norms, the ascription of responsibility, and perceived behavioural control have values q2 = 0.256, 0.307, 0.295, 0.255, 0.477, 0.439 and 0.213 respectively. These values can be regarded as moderately predictive and relevant. Some of the relationships associated with the exogenous variables provide moderate predictive relevance for behavioural intention to use Green IT in Nigerian manufacturing industries. This specifies that the more significant segment of the variances explained by the constructs hold for the model.

Table 6. Predictive relevance (q2)

Path	q^2
ATT -> IN	0.256
SN -> IN	0.439
PBC -> IN	0.213
PN -> IN	0.307
AC -> IN	0.295
AR -> IN	0.477
EC -> INT	0.255

6. Discussions and Hypotheses Testing Analysis

Following the recommendations of Hair et al., (2017), the structural model was evaluated using the path coefficients (β), t-values, p-values, and coefficient of determination (R^2). The model explains 64.2% of the variance in behavioural intention ($R^2 = 0.642$). The significance of the hypothesised relationships was assessed using the bootstrapping procedure with 5,000 resamples (Picheny et al., 2010; Sarkis et al., 2013). Figure 2 illustrates the structural model, while Table 7 presents the structural estimates used to evaluate the proposed hypotheses. Hypotheses were considered significant at $p < 0.05$ with corresponding t-values greater than 1.96.

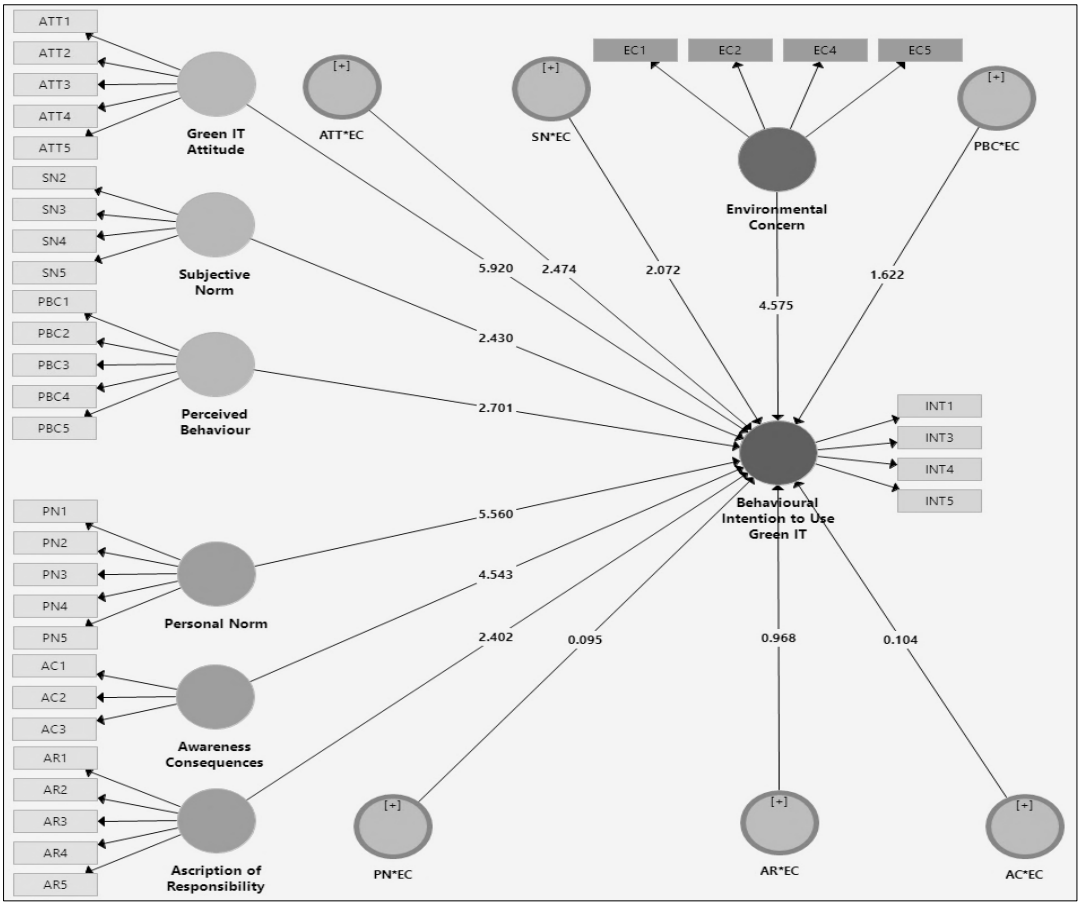


Figure 2. Structural model

Table 7. Structural estimates

No.	Path	Beta (β)	t-Value	p-value	Decision
H1	ATT -> IN	0.296	6.115	0.000	Supported
H2	SN -> IN	0.097	2.466	0.014	Supported
H3	PBC -> IN	0.139	2.746	0.006	Supported
H4	PN -> IN	0.246	5.513	0.000	Supported
H5	AC -> IN	0.257	4.554	0.000	Supported
H6	AR -> IN	0.129	2.450	0.014	Supported
H7	EC -> IN	0.237	4.641	0.000	Supported
H7a	ATT*EC->IN	0.140	2.429	0.015	Supported
H7b	SN*EC->IN	-0.099	2.090	0.037	Supported
H7c	PBC*EC->IN	-0.089	1.639	0.101	Not Supported
H7d	PN*EC->IN	0.004	0.097	0.923	Not Supported
H7e	AC*EC->IN	0.006	0.102	0.919	Not Supported

H7f	AR*EC->IN	0.046	0.981	0.327	Not Supported

Notes: Critical t-values. *1.96 (P < 0.05).

Importance Performance Matrix Analysis (IPMA) extends the results of PLS-SEM by simultaneously evaluating the importance and performance of each construct (Anderson & Fornell, 2000; Hair et al., 2013). In this study, importance was represented by the construct's total effect on behavioural intention, while performance was expressed on a 0 - 100 scale. Table 8 reports both measures, and Figure 3 presents the resulting importance performance map. Higher performance scores indicate stronger current performance, while higher total effects indicate greater importance for behavioural intention.

Importance Performance Matrix Analysis (IPMA) extends the results of PLS-SEM by simultaneously evaluating the importance and performance of each construct (Anderson & Fornell, 2000; Hair et al., 2013). In this study, IPMA was employed to provide additional insights into the relative importance and performance of the significant constructs influencing managers' intention to adopt Green IT. Table 8 and Figure 3 present the IPMA results, including the latent variable performance scores measured on a scale from 0 to 100. Higher scores indicate better performance and identify constructs that offer greater potential for improving Green IT adoption.

Table 8. Importance performance matrix results

Path	LV Index Values	LV Performances	Importance (Total Effect)
ATT -> IN	3.775	69.375	0.296
SN -> IN	3.745	66.013	0.097
PBC -> IN	2.729	43.233	0.139
PN -> IN	3.730	68.256	0.246
AC -> IN	3.369	59.215	0.257
AR -> IN	3.828	70.712	0.129
EC -> INT	3.170	54.238	0.237

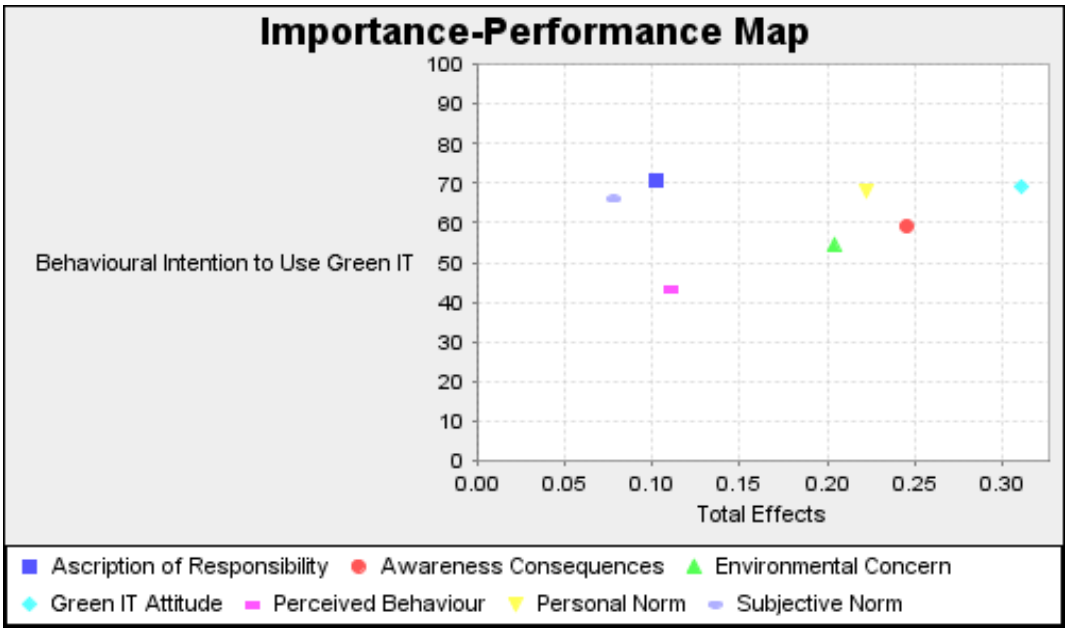


Figure 3. Importance performance map

6.2 Hypothesis H1

Hypothesis H1 proposed that managers' attitude (ATT) positively influences their intention to adopt Green IT in Nigeria's manufacturing sector. As shown in Figure 1 and Table 8, attitude has a significant positive effect on behavioural intention ($\beta = 0.296$, $t = 6.115$, $p < 0.001$). Therefore, H1 is supported, indicating that a positive attitude towards Green IT increases managers' intention to adopt it.

6.3 Hypothesis H2

Hypothesis H2 proposed that subjective norm (SN) positively influences managers' intention to adopt Green IT. The results indicate a significant positive relationship ($\beta = 0.097$, $t = 2.466$, $p = 0.014$). Therefore, H2 is supported, suggesting that social influence enhances managers' intention to adopt Green IT.

6.4 Hypothesis H3

Hypothesis H3 proposed that perceived behavioural control (PBC) positively influences managers' intention to adopt Green IT. The findings reveal a significant positive effect ($\beta = 0.139$, $t = 2.746$, $p = 0.006$). Therefore, H3 is supported, indicating that greater perceived behavioural control encourages Green IT adoption.

6.5 Hypothesis H4

Hypothesis H4 proposed that personal norm (PN) positively influences managers' intention to adopt Green IT. The results show a significant positive relationship ($\beta = 0.246$, $t = 5.513$, $p < 0.001$). Therefore, H4 is supported, suggesting that managers' moral obligation strengthens their intention to adopt Green IT.

6.6 Hypothesis H5

Hypothesis H5 proposed that awareness of consequences (AC) positively influences managers' intention to adopt Green IT. The findings indicate a significant positive effect ($\beta = 0.257$, $t = 4.554$, $p < 0.001$). Therefore, H5 is supported, demonstrating that greater awareness of environmental consequences promotes Green IT adoption.

6.7 Hypothesis H6

Hypothesis H6 proposed that ascription of responsibility (AR) positively influences managers' intention to adopt Green IT. The results demonstrate a significant positive relationship ($\beta = 0.129$, $t = 2.450$, $p = 0.014$). Therefore, H6 is supported, indicating that a stronger sense of responsibility increases managers' intention to adopt Green IT.

6.8 Moderating Effect of Environmental Concern

The moderating effects of environmental concern (EC) were assessed using the two-stage approach in PLS-SEM. The overall results indicate that environmental concern has a significant direct effect on managers'

intention to adopt Green IT (β = 0.237, t = 4.641, p < 0.001). The individual moderation hypotheses are presented below.

6.9 Moderation Hypothesis H7a

The results show that environmental concern significantly moderates the relationship between attitude and behavioural intention (β = 0.140, t = 2.429, p = 0.015). Therefore, H7a is supported, indicating that environmental concern strengthens the positive effect of attitude on Green IT adoption.

6.10 Moderation Hypothesis H7b

Environmental concern also significantly moderates the relationship between subjective norm and behavioural intention (β = -0.099, t = 2.090, p = 0.037). Therefore, H7b is supported.

6.11 Moderation Hypothesis H7c

The moderating effect of environmental concern on the relationship between perceived behavioural control and behavioural intention was not significant (β = -0.089, t = 1.639, p = 0.101). Therefore, H7c is not supported.

6.12 Moderation Hypothesis H7d

Environmental concern did not significantly moderate the relationship between personal norm and behavioural intention (β = 0.004, t = 0.097, p = 0.923). Therefore, H7d is not supported.

6.13 Moderation Hypothesis H7e

The moderating effect of environmental concern on the relationship between awareness of consequences and behavioural intention was not significant (β = 0.006, t = 0.102, p = 0.919). Therefore, H7e is not supported.

6.14 Moderation Hypothesis H7f

Environmental concern did not significantly moderate the relationship between ascription of responsibility and behavioural intention (β = 0.046, t = 0.981, p = 0.327). Therefore, H7f is not supported.

7. Summary of Findings

This study addressed three research objectives: (i) to identify the factors influencing decision-makers' intentions to adopt Green IT in Nigeria's manufacturing sector; (ii) to examine the relationships between these factors and behavioural intention; and (iii) to develop and validate a behavioural model for Green IT adoption.

7.1 First Research Objective

The first objective was to identify the factors influencing decision-makers' intentions to adopt Green IT in Nigeria's manufacturing sector. A systematic review of the literature and the instrument validation process identified seven key determinants: attitude, subjective norm, perceived behavioural control, personal norm, awareness of consequences, ascription of responsibility, and environmental concern. These factors provide the foundation for understanding behavioural intention towards Green IT adoption in the manufacturing sector.

7.2 Second Research Objective

The second objective examined the relationships between the identified factors and behavioural intention using Partial Least Squares Structural Equation Modelling (PLS-SEM). The results showed that nine of the thirteen proposed hypotheses (H1, H2, H3, H4, H5, H6, H7, H7a, and H7b) were supported. The findings indicate that attitude, subjective norm, perceived behavioural control, personal norm, awareness of consequences, ascription of responsibility, and environmental concern significantly influence managers' intention to adopt Green IT in Nigerian manufacturing organisations. Overall, the proposed model demonstrated good predictive capability in explaining behavioural intention.

7.3 Third Research Objective

The third objective was to develop and validate a behavioural model for Green IT adoption in Nigeria's manufacturing sector. An integrated model was developed based on the literature and theoretical foundations and evaluated using PLS-SEM with data collected from 210 managers and decision-makers. The results confirmed the reliability and validity of the measurement model and demonstrated that the proposed model effectively explains behavioural intention to adopt Green IT in the Nigerian manufacturing context.

8. Study Implications

8.1 Research Contributions and Implications

This study identified the factors influencing decision-makers' intention to

adopt Green IT and developed a valid and reliable behavioural model for Nigeria's manufacturing sector. The findings contribute to both theory and practice by providing empirical evidence on the determinants of Green IT adoption and offering a validated framework for future research and implementation.

8.2 Theoretical Implications

This study integrates the Theory of Planned Behaviour (TPB) and the Norm Activation Model (NAM) into a single framework for examining Green IT adoption. The results provide empirical support for the proposed model and demonstrate its suitability for explaining managers' behavioural intentions in the Nigerian manufacturing sector. The validated model may also serve as a useful framework for future studies in other industries and developing countries.

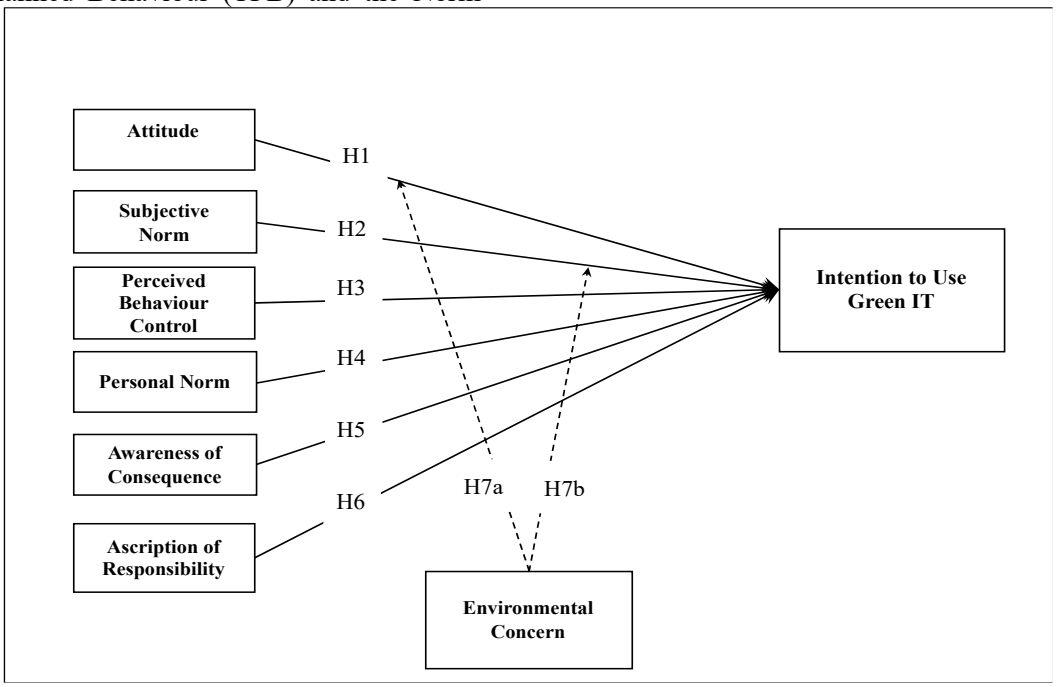


Figure 4. Behavioural Model for Intention to Use Green IT

8.3 Practical Implications

The findings provide practical guidance for managers, policymakers, and organisations seeking to promote Green IT adoption. By identifying the key determinants of behavioural intention, the study offers evidence to support the development of organisational strategies and policies that encourage environmentally sustainable IT practices and improve environmental performance.

8.4 Limitations

This study has several limitations. First, the data were collected from managers in selected manufacturing organisations in Nigeria, which may limit the generalisability of the findings. Second, all 210 valid responses were obtained from four organisations because only four of the five selected companies granted permission. Respondents within the same organisation may share organisational culture, policies and management practices, so the independence of observations assumed in conventional significance testing should be interpreted cautiously. Third, the study employed a quantitative cross-sectional survey; therefore, the findings reflect respondents' perceptions at a single point in time. Finally, the measurement model was refined by removing six indicators, and future studies should report and compare the full item-development and deletion process using the original SmartPLS output. Other potentially relevant constructs were also outside the scope of the model.

8.5 Future Research

Future research should examine Green IT adoption in other industries and countries to improve the generalisability of the findings. Additional studies could investigate the influence of other contextual factors, such as organisational culture and economic conditions, or examine alternative moderating and mediating variables. Future research may also employ qualitative or mixed-method approaches, including techniques such as the Delphi method, to provide deeper insights into decision-makers' perspectives on Green IT adoption.

9. CONCLUSION

This study examined the factors influencing managers' intention to adopt Green IT in Nigeria's manufacturing sector and developed an integrated behavioural model based on the Theory of Planned Behaviour and the Norm Activation Model. Using data from 210 managers and decision-makers and PLS-SEM, the findings showed significant direct effects of attitude, subjective norm, perceived behavioural control, personal norm, awareness of consequences, ascription of responsibility and environmental concern on behavioural intention. Environmental concern also significantly strengthened the attitude intention relationship but negatively moderated the subjective norm intention relationship, while the remaining four moderation effects were not significant. The validated model explains 64.2% of the variance in behavioural intention and provides practical guidance for managers and policymakers seeking to promote environmentally sustainable IT practices.

Ethical Clearance

This study was exempted from formal ethical approval because it involved an anonymous questionnaire survey of adult participants and posed no more than minimal risk. Participation was entirely voluntary, and informed consent was obtained from all respondents prior to data collection. The anonymity and confidentiality of participants were maintained throughout the study, and all data were collected and used solely for academic and research purposes.

Conflict of Interest

The authors declare that they have no known financial or non-financial conflicts of interest that could have influenced the work reported in this paper.

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