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Research Article

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The Role of Green Information Technology in Adopting Sustainable Products: An Analytical Study of the Opinions of a Sample of Workers at the Babylon Laboratory for Acid Battery Production

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Abstract: The current research seeks to identify the role of green information technology (GIT) as an independent variable through its dimensions (trends, practices, governance) in adopting sustainable products as a dependent variable, Babylon laboratory for the production of acid batteries, and the research adopted the descriptive analytical approach in the study The research sample included (138) laboratory workers Data on research variables were collected using the questionnaire in order to achieve the objective of the study Statistical programs such as SPSS V29) and (AmosV26) to analyze data, such as arithmetic mean, standard deviation, linear correlation coefficient, simple and multiple regression coefficient, and others, and the most prominent results were the existence of correlation and the impact of green information technology and the adoption of sustainable products, as well as this GIT is a vital tool for organizations to manage their sustainability, and the research made several recommendations, foremost of which was the need to use products bearing the Energy Star logo, as these products are manufactured taking into account the green environment and optimal energy consumption.

Keywords: Green IT, Sustainable Product Adoption, Trends, Practices, Governance.

INTRODUCTION

One of the considerations that necessity be occupied into account in the design procedure through green information technology is the considerations of achieving sustainability in design. Environmental concerns began as a result of the development of industry and technology and the multiplicity of products. Environmental problems prompted the attention of producers and consumers to monitor the negative impacts on the environment and work to develop and discover new technologies that prevent or reduce damage, to meet the needs of the current time deprived of cooperating the right of forthcoming peers and their ability to encounter their needs. Sustainable design is founded on using the principles of sustainability to design and develop products, which is a philosophy for designing environmental, material and service objects to be consistent with economic, social and environmental principles, and creating a long-term relationship between the producer and the user [1], [2] As a result, it became essential to use green information technology to foster empathy and peaceful coexistence in order to recognize issues and offer sustainable solutions, all of which contribute to the development of positive relationships between the environment, producers, and users.

Green information technology benefits the environment by lowering greenhouse gas emissions, increasing energy efficiency, employing fewer hazardous materials, and promoting recycling and reuse. GIT, then, encompasses all aspects of energy use economics, environmental sustainability, and total cost of ownership, which includes recycling and disposal costs. Concerns about disposing of electronic waste properly, new strict environmental regulations, growing awareness of the negative impacts of greenhouse gas emissions, and everything pertaining to upholding a company's reputation are the main factors pushing businesses and individuals to go green. Hence, the current research came to highlight the role of green information technology in adopting sustainable products, as well as research in identifying the problem, importance and objectives of this topic for the target sample, which leads to identifying the best ways and solutions that the target sample suffers from in order to apply the research topics and come out with the best performance and value

METHOD

Research Problem

Through the electronic survey of the intellectual outputs on the subject of our study, it was found that the lack of studies that reached research results can help organizations in developing a strategy for the adoption of information technology GIT and its practices, so this research focused on the role of information technology within Iraqi organizations because it has become an urgent environmental need and to promote the concept of information technology we must understand the following issues: What are the main environmental impacts caused by information technology? What are the main IT environmental issues we need to address? How can we make our IT infrastructure, products, services, processes, applications and practices environmentally sound? How can information technology help organizations and society as a whole in their efforts to improve our environmental sustainability?

Importance of Research

The importance of the study stems from the importance of preventing environmental pollution and trying to maintain its sustainability. At a time when the world is shifting towards economy in every consumer to achieve savings and reduce expenses, we hope that this study will follow the trend of this shift so that it helps organizations in the field of study (in particular) keep pace with this shift to achieve environmental sustainability.

Objectives of Research

1. Identify the key IT environmental issues we need to address.
2. Diagnosing the environmental problems resulting from the use of information and communication technology and trying to suggest solutions for them.
3. Trying to raise the level of maturity of the organizations' capabilities to qualify them to adopt or raise the project of building GIT.

Hypothetical Plan of Research

This paragraph's goal is to create a thorough plan that the study will follow in order to accomplish the goals you have in mind (see Figure 1), and as a result, the research variables can be identified as follows: -

1. The independent variable: - It is represented by green information technology, which includes three dimensions: (Trends, practices, governance), and the scale [3] was adopted.
2. The dependent variable: - It is represented by the adoption of sustainable products, which includes four dimensions: (Design, Recycling, Remanufacturing, Reuse), and the scale [4] was adopted.

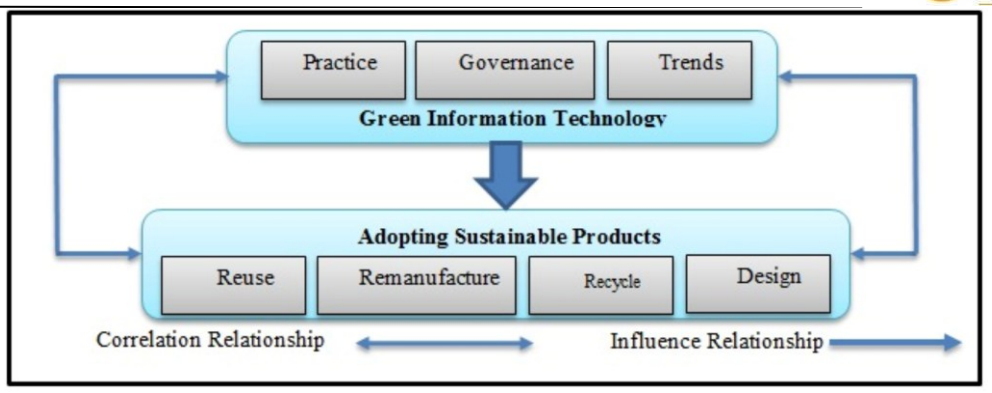

Figure 1. Hypothesis scheme of research
Source: Prepared by researchers

Research Hypothetical

H1: There is a significant correlation between GIT and the adoption of sustainable products.
H2: There is a significant effect of GIT on the adoption of sustainable products.

Research Sample

The study community is Babylon Laboratory for the production of acid batteries, while its sample is its managers and workers. Among the most important reasons that prompted us to choose the study community and sample (random sample) is that it is the most mature in terms of capabilities and potential, and because they are the most familiar with using GIT applications. The sample size reached (138) individuals.

Concept Of Green Information Technology

The primary support system and crucial motivator for reducing uncertainty in the workplace is information. Information is any form of knowledge, ideas, facts, data, or mental labor that is conveyed in any form, whether formally or informally. It also refers to everything that a person possesses for his work, research, structure, and all of its requirements [5]. In turn, [6] sees that information technology represents methods and techniques for creating, storing, producing and retrieving data [7]), developing knowledge and improving management capabilities in managing its technical and social operations. [8] indicated that information technology mentions to a usual of procedures, tools and methods that serve the comprehensive use of information. On the other hand, the term GIT represents a modern concept and does not have a common definition, as it works on a set of initiatives and strategies that reduce the environmental impact of technology [1], in addition to the fact that the revolution in information technology has touched its dimensions and media with computers and networks that will reduce the levels of its use of operational energies that are hoped to reduce or eliminate pollution and toxic waste while achieving better performance for organizations and contributing to achieving quality in management and production [9]. [10] indicated that it is the sum of technological techniques adopted by the organization in order to achieve social, economic and environmental responsibility. On the other hand, [11] defined it as the sum of green practices adopted by the organization to ensure the achievement of greening in its internal and external operations. For his part, [12] defined it as the sum of techniques and behaviors adopted by the organization as behavior that supports and preserves the environment in a way that contributes to improving the efficiency of its resources and the energy it uses.

In summary, GIT can be defined as a concept that refers to the use of IT and its techniques in sustainable and environmentally approachable ways, in a way that contributes to reducing the environmental impact of information systems, reducing energy and resource consumption, and managing electronic waste. This is achieved through a set of sustainable practices and techniques in the design, operation, and management of information systems.

Importance Of Green Information Technology

The importance of GIT emerges from organizations' awareness of the importance of adopting important initiatives that contribute to improving their environmental impacts, reducing damage to the environment, maximizing efficiency, and allowing for the reduction of

emissions, which enhances creativity and technological innovation. From this basis, the importance of information technology can be determined in the following points: -

1. Reducing operating costs that may affect environmental sustainability.
2. Compliance with laws and legislation governing environmental conservation.
3. Preserving the environment by adopting environmentally friendly technologies and behaviors that serve the interests of society [13].
4. Reducing the negative impacts that organizations leave on the environment and increasing their efficiency in energy consumption.
5. Enhancing the organization's role in creating a competitive environment based on its adoption of environmentally friendly technologies [14].
6. Gaining a competitive advantage by differentiating the organization from its competitors.
7. Upgrading old equipment using newer and greener network equipment.

Dimensions Of Green Information Technology

The dimensions of attitudes and practices are elements of the human infrastructure of information technology, while the administrative capacity of information technology is related to the policies adopted by the organization, in addition to its focus on technology and governance of its internal operations. Accordingly, GIT can be measured through three common dimensions, which are [15].

Trends (Positions): Green IT plays an important role in promoting environmental sustainability and improving the impact of technology on the environment [16]. This technology includes a set of initiatives and positions that seek to achieve sustainability goals. Green IT initiatives also rely on the use of renewable energy sources such as solar and wind energy to operate information and communication systems. This contributes to reducing dependence on fossil fuels and carbon emissions [17].

Practices: Information technology is an important tool for acquiring and processing information to support human goals [18]. According to [19], information technology contributes to reducing competition by improving productivity, profitability, and quality of operations. According to [20], the effective application of information technology significantly impacts human resource management by reducing costs and improving human resource services, allowing human resource management to become a strategic partner.

Governance: The role of individual decision-makers should not be ignored, as GIT represents a systematic application of environmental sustainability standards that contributes to preventing pollution, supervising products, and using clean energy to build, provide, use, and dispose of information technology infrastructure. This enables management to influence organizational policies and practices in building technical initiatives that contribute to determining the priorities of procedures and preserving the environment [13]. The ability to hold officials accountable for their management of public resources and the establishment of an integrated system of political and administrative accountability for officials in their public positions, civil society organizations, and the private sector are prerequisites for governance [21].

The Concept Of Embrace Sustainable Products

According to [22], sustainable products are those that safeguard the environment and public health during their whole life cycle, from the extraction of raw materials to the final disposal of the product. According to [23], it is the utilization of products and services that improve quality of life, satisfy basic needs, and use fewer natural resources. According to [24], it increases the product's reusability, durability, upgradability, and reparability. The notion of sustainable products takes into account a number of social, economic, and environmental factors [25]. A sustainable product is one that respects the environment and all of its constituent parts through environmentally conscious design methods. In order to find the best performance through a balance between effort and achievement, research is used to determine the suitability of work with the result through conscious design [26]. The descriptive model of the product process can be imagined as a set of successive systems that are at the same time intertwined determinants of this complex process [27]. Accordingly, the sustainable product is the approach that takes into account the integration between considerations and systems related to sustainability without compromising the foundations or

design considerations of the product's function or purpose [28]. The sustainable product is also one of the most important trends, due to its comprehensiveness, as it takes into account the environmental dimension in the product design process [29], in addition to the economic and social dimensions [30]. A sustainable product is represented by treatments that make the design sustainable, whether in material, form or function, in line with economic and social trends and the surrounding environment, achieving cultural and intellectual communication across generations [2].

Sustainable Product Principles

When working on a sustainable product, several principles must be taken into account to explain how to achieve sustainability in design, as follows: -

Shape: Before starting to design the plans, the designer must ask questions about how shape affects energy consumption, and also about the effect of size on packaging in addition to transportation costs and fuel emissions. For example, IKEA is implementing a flat packaging strategy to help reduce transportation costs, fuel use, and resulting emissions [31].

Function And Ease Of Use: The function and ease of use of the product contribute to its sustainability. Helping consumers use the product easily and in less time, and with less energy consumption, can ensure reducing waste, as consumers do not want to keep products that are difficult to use [32].

Cost-Effectiveness Of Solutions: Cost is one of the main obstacles that prevent many customers from relying on sustainable products instead of unsustainable ones, so the responsibility of reducing the cost of current sustainable products falls on designers and decision makers [33].

Renewable Energy: We must stop relying on carbon energy and think about innovating products that rely on clean and renewable energy, such as wind farms and solar panels [34].

Materials And Recycling: Using materials that can be easily recycled or that are naturally renewed in a short period of time, such as relying on mixed woods like IKEA and innovative materials to replace traditional types that may take a long time to grow again, as mixed and recycled materials help reduce production costs [31].

Durable Design Solutions: To get rid of waste, products must be either durable enough to last for a long time, or can be completely recycled to turn into new products, both methods can help in recycling more than once and reduce dependence on natural resources [34].

Dimensions of Sustainable Products

Sustainable Products can be measured through four dimensions:

Design: The process of redesigning and rehabilitating products by developing their functional performance and improving their aesthetic appearance is based on a precise analytical study of the industrial product that needs to be developed, where it is examined and studied in whole and in part, and then identifying the method of its functional performance and arriving at the methods and techniques of producing its parts in all its different stages [25], identifying the materials used to produce its parts and studying them, and then determining the functional shortcomings and mechanical defects in the product from its energy consumption or short operating life or that the materials used in producing its parts harm the surrounding environment or a shortcoming in the functional performance designed for it [32].

Recycling: Recycling is the process of creating new products out of waste or used materials. [25] Energy consumption, waste of potentially useful materials, air and water pollution, and greenhouse gas emissions are all decreased during the recycling process. Recycling therefore contributes to environmental preservation and improves human well-being [32].

Remanufacturing: Remanufacturing and comprehensive refurbishment (value retention processes throughout the entire useful life) are standardized and intensive industrial processes that provide the opportunity to add value and benefit to the useful life of the product [28]. It is the process of using old products to produce new products of the same or similar category. In this process, old products such as mobile phones or cars are collected, then disassembled and their parts or biodegradable materials are used to produce new products in the same industry [25].

Reuse: It is the act or practice of using an item, either for its original purpose (traditional reuse) or to perform a different function [32]. It is the process of using products or materials

again for the same or a different purpose, without significantly changing their form or quality [28]. In broader economic terms, reuse can provide high-quality products for people and organizations with limited resources, in addition to providing jobs and business activity that contributes to supporting the economy [25].

RESULT AND DISCUSSION

Result

Description And Stability Of Research Variables

This paragraph aims to code the research variables to introduce the reader to the most important variables that were addressed and to determine the dimensions and paragraphs for each of these variables (GIT, and adoption of green products), in addition to measuring the level of stability of the measurement tool towards the research sample through testing the Cronbach's alpha coefficient for the dimensions and variables of the research. Accordingly, the research results showed that the stability coefficient of the measurement tool for the GIT variable reached (0.964), while the stability coefficient of adoption of sustainable products was (0.902), and this shows the consistency and consistency of the study variables in their dimensions, in addition to the validity of the questionnaire tool towards the target sample.

Table 1. Description and stability of research variables

Variables	Dimensions	Paragraphs	Code		Reliability	
Green	Trends	3	GITT	GIT	0.892	0.964
Information	Practices	6	GITP		0.904	
Technology	Governance	6	GITG		0.920	
Adopting	Design	4	SPAD	SPA	0.926	0.902
Sustainable	Recycling	6	SPAR		0.905	
Products	Remanufacturing	4	SPAM		0.932	
	Reuse	4	SPAU		0.907	

Data Moderation And Inflation Testing

The data normality test contributes to defining a basic concept for data analysis of the dimensions of the dependent variable and then interpreting the mechanism of data distribution in a parallel manner around the value. Therefore, the normality test aims to understand that there are no extreme values or abnormal values that affect the results. Hence, it appears from the results of Table (2) that the data follow a normal distribution, which paves the way for the possibility of generalizing the results to the researched community. The results in Table (2) also show that the inflation test for the dimensions of the independent variable indicates the validity of the assumption of the data normality. Therefore, this test contributes to determining whether the data shows a large variance or an unexpected variance, which may affect the accuracy of the results

Table 2. Data normality test and inflation test

Variable/Tests		Trends	Practices	Governance	Design	Recycle	Remanufacture	Reuse	Adopt sustainable products
Moderation Test	**Test Statistic**	-----	-----	-----	0.232	0.236	0.205	0.232	0.234
	Sig.	-----	-----	-----	0.200	0.200	0.200	0.200	0.200
Inflation Test	**VIF**	5.234	5.258	4.272	-----	-----	-----	-----	-----

Variable/Tests	Trends	Practices	Governance	Design	Recycle	Remanufacture	Reuse	Adopt sustainable products
Tolerance	0.191	0.190	0.234	-----	-----	-----	-----	-----

Description Of Search Variables

The results of Table (3) show that the overall rate of the GIT variable was (3.78) with a standard deviation equal to (1.22) and a relative importance of (76%). Accordingly, by analyzing the results of the study, we note that the trends dimension (GITT) received the highest rate of interest from users of Babylon acid batteries, as the arithmetic mean was 3.84 with a standard deviation of 1.41 and a relative importance of 77%. This indicates that users are very interested in knowing the latest trends in the field of acid batteries, and are looking for information about new technologies, developments in battery performance, and any improvements in their lifespan. On the other pointer, the governance dimension (GITG) received the lowest rate of interest, as the arithmetic mean was 3.70 with a standard deviation of 1.15 and a relative importance of 74%. This indicates that users are less interested in knowing the aspects related to governance in the field of acid batteries, such as laws and regulations, corporate social responsibility, and sustainable production processes. The results of Table (3) also specify that overall rate of the sustainable products adoption variable was (3.76) with a standard deviation of (1.28) and a relative importance of (75%). By analyzing the results of the study, we note that the design dimension (SPAD) received the highest rate of interest from users of Babylon acid batteries, as the arithmetic mean was 3.78 with a standard deviation of 1.30 and a relative importance of 76%. This indicates that users are greatly interested in the design of acid batteries, and are looking for information about the design features, construction materials, and manufacturing techniques, and the extent of the design's impact on battery performance. On the new pointer, the remanufacturing dimension (SPAM) received the lowermost rate of interest, as the arithmetic mean was 3.73 with a standard deviation of 1.23 and a relative importance of 75%. This indicates that users are less interested in knowing the aspects related to the remanufacturing of acid batteries, such as the possibility of recycling them, the extent of the impact of remanufacturing on the environment, the existence of remanufacturing programs, and their availability.

Table 3. Descriptive statistics for research variables

NO.	mean	S.D	"Percent"	NO.	mean	S.D	"Percent"	NO.	mean	S.D	"Percent"
GITT1	3.86	1.43	77%	GITG4	3.67	1.27	73%	SPAR5	3.80	1.38	76%
GITT2	3.83	1.40	77%	GITG5	3.65	1.11	73%	SPAR6	3.71	1.34	74%
GITT3	3.83	1.40	77%	GITG6	3.65	1.31	73%	SPAR	3.78	1.32	76%
GITT	3.84	1.41	77%	GITG	3.70	1.15	74%	SPAM1	3.74	1.31	75%
GITP1	3.73	1.47	75%	GIT	3.78	1.22	76%	SPAM2	3.75	1.32	75%
GITP2	3.61	1.48	72%	SPAD1	3.77	1.39	75%	SPAM3	3.73	1.27	75%
GITP3	3.90	1.47	78%	SPAD2	3.80	1.31	76%	SPAM4	3.70	1.35	74%
GITP4	3.93	1.45	79%	SPAD3	3.72	1.42	74%	SPAM	3.73	1.23	75%
GITP5	3.84	1.38	77%	SPAD4	3.83	1.36	77%	SPAU1	3.75	1.35	75%
GITP6	3.80	1.33	76%	SPAD	3.78	1.30	76%	SPAU2	3.75	1.39	75%
GITP	3.80	1.29	76%	SPAR1	3.76	1.34	75%	SPAU3	3.78	1.32	76%
GITG1	3.75	1.26	75%	SPAR2	3.83	1.40	77%	SPAU4	3.74	1.30	75%
GITG2	3.81	1.39	76%	SPAR3	3.90	1.43	78%	SPAU	3.75	1.29	75%
GITG3	3.67	1.36	73%	SPAR4	3.83	1.41	77%	SPA	3.76	1.28	75%

Testing Research Hypotheses

H1: There is a significant correlation between green IT and adoption of sustainable products. The results of Table (4) indicate the existence of a significant correlation between GIT and

the adoption of sustainable products, with a value of (0.839), which shows that the target sample seeks to keep pace with the development in the marketing business environment and adapt to changes by adopting new products. The results also show the being of a correlation between the dimensions of GIT and the dimensions of adopting sustainable products, ranging from (0.773) between trends and reuse, to (0.885) between governance and remanufacturing, which proves the validity of the first main hypothesis.

Table 4. Correlation Matrix

Variable	GITT	GITP	GITG	GIT	SPAD	SPAR	SPAM	SPAU	SPA
GITT	—								
GITP	0.878	—							
GITG	0.848	0.851	—						
GIT	0.96	0.957	0.939	—					
SPAD	0.796	0.832	0.844	0.863	—				
SPAR	0.851	0.883	0.836	0.899	0.898	—			
SPAM	0.822	0.803	0.885	0.876	0.931	0.857	—		
SPAU	0.773	0.795	0.85	0.845	0.871	0.777	0.9	—	
SPA	0.775	0.784	0.842	0.839	0.872	0.763	0.896	0.996	—

H2: There is a significant impact of green IT on the adoption of sustainable products.
The results of the standard model in Table (5) showed that GIT affects the adoption of sustainable products for the target sample, which means that increasing GIT by (0.875) contributes to subsidiary the mechanisms used to adopt sustainable products, and this has a standard error of (0.049), and a critical value identical to (17.857), which means that GIT plays an important role in encouraging the adoption of sustainable products, and this proves the validity of the second hypothesis.

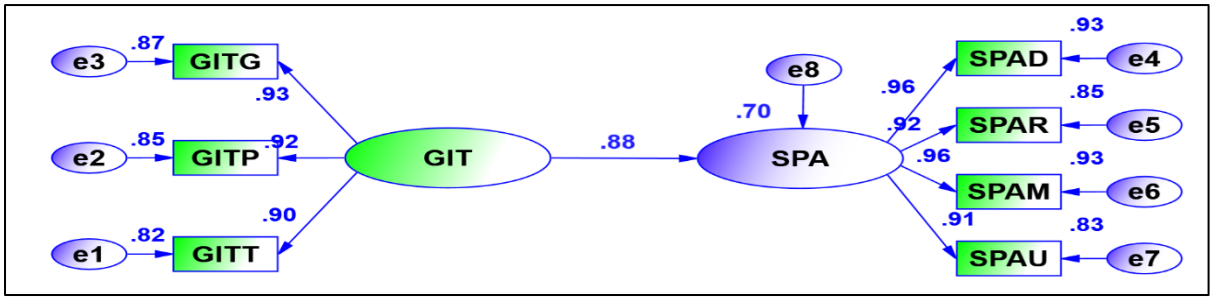

Figure 2. The measurement model for influence of GIT on the adoption of sustainable products

The results of Table (5) show that the reasons that contributed to improving the adoption of sustainable products are due to the contribution of GIT in explaining (0.704) of the square of variance in the adoption of sustainable products.

Table 5. Outputs of the measurement model for the impact of GIT on the adoption of sustainable products

	Path		Estimate	S.E	C.V-value	R2	F	Sig.
GIT	--->	SPA	0.875	0.049	17.857	0.704	323.257	0.001

The results demonstrate that both constructs were measured consistently. Cronbach's alpha values of 0.964 for green information technology and 0.902 for sustainable product adoption substantially exceed the commonly accepted threshold for exploratory organizational research. The descriptive findings also show relatively high implementation levels: GIT obtained a mean of 3.78 (76%), while sustainable product adoption obtained a mean of 3.76

(75%). Among the GIT dimensions, trends recorded the highest mean, whereas governance was the lowest. This pattern suggests that awareness of technological developments is more advanced than the formal policies, accountability mechanisms, and sustainability controls needed to institutionalize green practices. This interpretation is consistent with the view that Green IT requires not only efficient technology but also coordinated organizational policies and managerial governance [1], [15].

The strong positive correlation between GIT and sustainable product adoption ($r = 0.839$) supports H1 and indicates that higher levels of green technological orientation, practice, and governance are associated with stronger attention to sustainable design, recycling, remanufacturing, and reuse. The correlations across the dimensions, which range from 0.773 to 0.885, further show that the relationship is broad rather than being driven by a single component. The particularly strong association between governance and remanufacturing ($r = 0.885$) is meaningful because remanufacturing depends on formal procedures for recovery, quality control, responsibility, and resource allocation. Previous research similarly describes governance and organizational capability as important mechanisms for translating environmental intentions into operational Green IT initiatives [13], [21] and identifies circular design, reuse, and value-retention processes as core elements of sustainable products [24], [28].

The structural model supports H2. The standardized effect of GIT on sustainable product adoption was 0.875, with a standard error of 0.049, a critical value of 17.857, and a significance level of 0.001. In addition, the model explained 70.4% of the variance in sustainable product adoption ($R^2 = 0.704$), while the F value of 323.257 confirms the model's overall statistical significance. These findings imply that GIT is not merely an operational support function in the laboratory; it is an important organizational capability for improving product information, monitoring energy and material use, coordinating recycling and reuse, and supporting sustainable production decisions. This conclusion aligns with evidence that Green IT can improve resource efficiency and environmental performance [9], [12], while sustainable product adoption depends on integrated design and circular-economy practices throughout the product life cycle [2], [27], [30].

Discussion

Nevertheless, the results should be interpreted within the study's cross-sectional and single-organization design. The statistical associations establish a strong relationship but do not, by themselves, demonstrate long-term causality. The relatively high VIF values for trends and practices also indicate substantial overlap among the GIT dimensions, although the reported tolerance values remain above the minimum critical level. Future studies should test the model in multiple manufacturing organizations, employ longitudinal data, and include objective environmental indicators such as energy consumption, emissions, material recovery, and battery recycling rates. Such extensions would help determine whether improvements in governance produce sustained operational and environmental outcomes beyond employees' questionnaire responses.

CONCLUSION

The study concludes that green information technology is a vital organizational capability for managing sustainability because it provides a comprehensive basis for evaluating, planning, and improving technological practices, strengthens the maturity of operational processes, and helps reduce environmental impacts related to greenhouse-gas emissions, toxic pollution, and energy and water consumption. The empirical evidence confirms a strong positive relationship between GIT and sustainable product adoption and shows that GIT explains a substantial proportion of the variance in sustainable design, recycling, remanufacturing, and reuse. Accordingly, the Babylon Laboratory for acid battery production should prioritize energy-efficient products and equipment carrying recognized labels such as Energy Star, strengthen governance policies and accountability for green technology, provide public and employee education on environmentally responsible electronic products and end-of-life disposal, and apply a Green Technology Framework that reduces carbon emissions without compromising product quality, responsiveness, or resource availability. Government and institutional

stakeholders should also consider incentives, including appropriate tax relief, for organizations that adopt clean technology, green products, and renewable energy. Future research should extend the analysis across multiple organizations and periods and incorporate objective measures of energy use, emissions, waste recovery, and recycling so that the long-term environmental and operational effects of Green IT can be assessed more rigorously.

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