ISSN: 2349 - 4891
International
Journal of Recent Research and Applied Studies
(Multidisciplinary Open Access Refereed e-Journal)

Green Intelligence: The Role of Digital Technologies in Business Sustainability

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Abstract
In today's scenario, every organisation is vastly using digital technologies to meet sustainability targets and compete in a changing business ecosystem. Green Intelligence means real-time environmental performance improvement capabilities using a digital technology toolkit that ramps up decision-making and sustainability solutions based on Artificial intelligence, cloud computing power, big data analytics techniques like Machine learning, IoT-enabled environmental sensing, and diverse automated systems. This green intelligence braces the todays corporate to save energy, reduce waste and enhance operations beyond their capability of providing data -driven insights that support the economic environment and social sustainability. Stakeholders, shareholders and regulators are looking for sustainable development more than ever before; companies are adopting green digital solutions for their daily processes to build long-term value. The objective of this article is to comprehend the effect of the use of digital technologies on business sustainability, which evaluates operational efficiency, sustainability, innovation and organisational performance. The study is expected to offer new perspectives for managers and policymakers seeking to lead digital transformation as a route to sustainable business growth.

Introduction

Business sustainability is now a major concern for businesses due to growing environmental challenges, resource scarcity, climate change, and rising stakeholder expectations. Companies are being evaluated not only on their financial success but also on their social and environmental obligations. Consequently, companies are adopting sustainable strategies that balance economic growth, environmental conservation, and social advancement. One of the most potent forces behind sustainability is digital transformation. Artificial intelligence (AI), big data analytics, cloud computing, the Internet of Things (IoT), blockchain, automation, and other technologies are making it possible for businesses to increase productivity, use less resources, and promote ecologically friendly operations. Green intelligence, which stands for the use of digital capabilities to accomplish sustainable business objectives, is frequently used to describe the integration of modern technologies into sustainability projects.

Through real-time data analysis, green intelligence assists businesses in tracking energy consumption, streamlining supply chains, reducing carbon emissions, minimising waste, and enhancing decision-making. By making it possible to create sustainable business models, eco-friendly products, and effective resource management systems, digital technologies also promote creativity. Consequently, companies can attain both long-term sustainability and a competitive edge. Meanwhile, governments, investors, and customers are placing a greater emphasis on Environmental, Social, and Governance (ESG) policies, which pushes businesses to implement cutting-edge, sustainable solutions. It is now crucial to comprehend how digital technologies and corporate sustainability are related. Thus, this study investigates how green digital technologies support long-term organisational success and sustainable business practices.

Objectives of the Study

To examine the respondents' socioeconomic characteristics and their perspective on the implementation of digital green technology in their companies.

To examine the association between demographic and occupational characteristics and digital technology adoption for sustainability.

To spot any substantial variations in the demographics and organisational characteristics of green digital technologies.

To analyse the influence of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes.

Hypothesis for the study

Ho: There is no significant association between socio economic profile and occupational features and digital technology adoption for sustainability.

Ho: There is no significant difference among the factors of green digital technologies on demographics and organisational features.

Ho: There is no significant influence of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes.

Research Methodology

The data were collected from 152 respondents. The statistical tools employed in the study were percentage analysis, Chi-square, Linear Multiple regression and one-way analysis of variance.

Review of Literature

Sikandar Rahman et al (2025) conducted the study to find how green innovation influenced sustainable performance and as well the way green knowledge exchange and green dynamic capabilities function as mediators. Moreover, the moderating impact of Artificial Intelligence on these correlations was also to be examined. The result of the study showed that sustainable performance was positively correlated with green innovation and it was mediated by green information sharing and green dynamic capabilities, and sustainable performance was considerably regulated by Artificial Intelligence. These outcomes imply that incorporating Artificial Intelligence into SME'S can improve the efficacy and promotion of green innovation methods.

Yicheng Qain &Ling Cao (2025) designed the article to study the connection between corporate green transformation and innovation in digital technology, to spot the mechanism through which digital technology innovation influences green transformation and to examine how operational efficiency functions as a mediator in the interaction between green transformation and digital technology innovation. The findings of the study indicated that innovation in digital technology significantly promoted enterprise in green transformation were mediated by operational efficiency. Businesses can reduce resource waste and enhance their environmental performance through improvements in the allocation of resources, production efficiency and total factor productivity.

Timo Philiph Botcher et al (2023) researched the article to study the increasing significance of digital innovation in attaining a sustainable economy. The researchers emphasised how technologies like big data analytics, blockchain, artificial intelligence and the Internet of Things may promote sustainability throughout value chains and organisational roles. Digital technology can help organisations cut waste, carbon emissions, and resource usage while also increasing efficiency, transparency, and connectedness.

Research gap

The existing literature establishes that digital technologies and green innovation contribute to sustainability and organisational performance. However, limited studies have examined the differences in perceptions of green digital technology adoption across demographic and organisational characteristics and the combined influence of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes. Therefore, the present study attempts to address this gap by developing an integrated perspective of green digital technology adoption its organisational outcomes.

Data Analysis and Interpretation

Percentage Analysis

Particulars	Dominant Group	Percentage
Gender	Female	56.6%
Age	Below 25	69.7%
Educational qualification	Undergraduates	69.7%
Occupational sector	Manufacturing	39.5%
Organization size	Medium (50-250 employees)	63.2%
Years of experience	3 to 10 years	52.6%
Digital technology	Artificial intelligence	38.2%
Reason for Adoption	Reduce environment impact	35.5%
Business Area Benefitted	Marketing	31.6%
Environment Benefits	Better resource utilization	32.9%
Technology having greatest potential to reduce energy consumption	Automation	30.3%
Frequency of usage	Always	47.4%
Biggest Barrier to adopt green digital technologies	High implementation cost	36.8%
Support Required to adopt green digital technologies	Management Commitment and government incentives	30.3%

The table given above shows that, sample was dominated by female respondents who are all under the age of 25. This sample consists of undergraduates participating from the manufacturing sector, medium-sized firms and they have 3-10 years of experience. In terms of technology and sustainability, to reduce the environmental impact, artificial intelligence was most widely adopted. Marketing is considered as the most benefitted business area, with better resource utilization being the most frequently considered environmental benefit. Respondents also trust that automation has the greatest potential to reduce energy consumption. According to majority of the respondents, organizations use sustainability data in business decisions. But high cost of implementation is the biggest barrier to adopt green digital technologies. Respondents strongly believe that commitment of the management and incentives from government will be required to adopt green digital technologies.

Chi-square analysis

A chi-square analysis was used to analyse the association between specific demographic and organizational factors on the adoption and usage of digital technologies for sustainability. This study aimed to establish whether digital technology usage, frequency of sustainability data utilization and adoption-related issues differ between respondent and organizational categories.

Ho: There is no significant association between socio-economic profile and occupational features and digital technology adoption for sustainability.

Ha: There is a significant association between socio-economic profile and occupational features on digital technology adoption for sustainability.

S. No.	Variables	Pearson χ^2	df	p-value	Result
1	Gender × Digital Technology Used	24.431	3	0.000	**Significant**
2	Age × Digital Technology Used	15.540	6	0.016	**Significant**
3	Educational Qualification × Digital Technology Used	6.344	6	0.386	Insignificant
4	Occupational Sector × Frequency of usage	34.248	8	0.000	**Significant**
5	Organization size x Biggest Barrier to adopt green digital technologies	19.857	8	0.011	**Significant**
6	Organization size x Support Required to adopt green digital technologies	2.782	8	0.947	Insignificant

From the above table it is clear that gender and age are having a significant association with the digital technology used at 5% level. The selection of digital technologies such as AI, IoT, cloud or others appears to change according to gender and age. Selection of digital technology is not significantly associated with educational qualification. Occupational sector is significantly associated with frequent use of sustainability data because organisations in different sectors may have varied sustainability-related activities and different requirements for using information. There is an association between the size of the organisation and the major barrier to green digital technology adoption. Therefore, small, medium and large organisations do

not face the same pattern of adoption barriers. There is no association between the size of the organization and the support required to adopt green technologies. All the organisations, small, medium and large, have similar patterns in their support requirements to adopt green digital technologies.

ONE-WAY ANOVA

One-way ANOVA was applied to find out the significant differences in respondents' perceptions of green technology adoption and innovation, environmental sustainability, operational efficiency and business and competitive outcomes across age, gender, educational qualification, occupational sector and organisation size.

Ho: There is no significant difference in the factors of green digital technologies on demographics and organizational features.

Ha: There is a significant difference among the factors of green digital technologies on demographics and organization features.

Grouping Variable	**Factor**	**F-value**	**p-value**	**Decision**
Gender	Technology Adoption & Innovation	3.025	0.084	Not Significant
	Environmental Sustainability	5.171	0.024	**Significant**
	Operational Efficiency	2.923	0.089	Not Significant
	Business & Competitive Outcomes	2.785	0.097	Not Significant
Age	Technology Adoption & Innovation	1.089	0.339	Not Significant
	Environmental Sustainability	0.848	0.43	Not Significant
	Operational Efficiency	1.387	0.253	Not Significant
	Business & Competitive Outcomes	0.614	0.543	Not Significant
Educational Qualification	Technology Adoption & Innovation	0.048	0.953	Not Significant
	Environmental Sustainability	0.97	0.382	Not Significant
	Operational Efficiency	0.806	0.448	Not Significant

Grouping Variable	Factor	F-value	p-value	Decision
	Business & Competitive Outcomes	3.428	0.035	**Significant**
Occupational Sector	Technology Adoption & Innovation	5.018	0.001	**Significant**
	Environmental Sustainability	5.845	0.000	**Significant**
	Operational Efficiency	8.522	0.001	**Significant**
	Business & Competitive Outcomes	7.831	0.000	**Significant**
Organization Size	Technology Adoption & Innovation	25.287	0.011	**Significant**
	Environmental Sustainability	11.642	0.031	**Significant**
	Operational Efficiency	12.057	0.001	**Significant**
	Business & Competitive Outcomes	11.564	0.023	**Significant**

From the above table, it is found that the four factors of green digital technologies vary significantly across demographic and organizational features. Gender shows a significant difference only for environmental sustainability ($F = 5.171$, $p = 0.024$), but the remaining factors are not significant. This shows that both male and female respondents have different perceptions regarding the environmental sustainability merits of green digital technologies. Age does not have a statistically significant difference in the perceptions regarding green digital technologies at 5% level. Only in business and competitive outcomes, educational qualification make a meaningful difference. ($F = 3.428$, $p = 0.035$). It may be due to the respondents' exposure in understanding the strategic implications of green digital technologies.

Respondents' education does not differ significantly in perception regarding green digital technologies at the 5% level. The result shows that respondents with different levels of education have broadly similar perceptions of green digital technologies. The lack of significant difference may be because respondents share similar workplace experience access to information, exposure to digital technologies or awareness of sustainable practices, regardless of their educational qualifications. Organisational characteristics such as occupational sector and organization size shows significant

differences across four factors ($p < 0.05$), indicating that respondents from different occupational sectors and organization size have different perceptions of technology adoption, environmental sustainability, operational efficiency and competitive outcomes.

Regression Analysis

Multiple linear regression analysis was conducted to identify the influence of technology adoption, environmental sustainability and operational efficiency on the business and competitive outcomes of green digital technologies.

Ho: There is no significant influence of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes.

Ha: There is a significant influence of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes**.**

Impact of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes.

R	R Square	Adjusted R Square	Std. Error of the Estimate
.946(a)	0.895	0.893	0.27035

The above table shows R square value is 0.895 and adjusted R square value is 0.893. This implies that technology adoption, environmental sustainability and operational efficiency factors are able to influence business and competitive outcomes at 89.5% level which is statistically significant. The complete relationship can be consolidated and estimated through the following ANOVA table.

	Sum of Squares	df	Mean Square	F	Sig.
Regression	92.486	3	30.829	421.804	.000
Residual	10.817	148	0.073		
Total	103.303	151			

The above table shows F = 421.804 and p-value = 0.000, which is significant at 5% level. This proves that the three variables of green digital technologies, such as technology adoption, environmental sustainability and operational efficiency, were deeply influenced by the dependent variable, business and competitive outcomes of green digital technologies. The individual influences of the independent variables of green digital technologies are as follows.

Individual influences of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes.

Influencing Variables	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
	B	Std. Error	Beta		
(Constant)	.073	.108		.677	.499
Technology adoption	.001	.057	.001	.022	.982
Environmental sustainability	.187	.058	.186	3.231	.002
Operational efficiency	.789	.069	.777	11.502	.000

From the above table, it is determined that, environmental sustainability (β = 0.187, t = 3.231, p = 0.002) and operational efficiency (β = 0.789, t = 11.502, p = 0.02) are statistically significant at the 5% level. Since the beta values are positive, there is a positive significant influence of technology adoption, environmental sustainability and operational efficiency on business and competitive outcomes. The study shows that organisations that embrace modern technology, implement sustainable practices and upgrade their operational processes are more likely to achieve better performance, stronger competitiveness and improved business results of the business.

Conclusion

According to the studies' findings, digital technologies play a vital role in promoting business sustainability by enabling organisations to integrate environmental considerations with operational and strategic decision-making. Technologies such as Artificial Intelligence, Internet of Things, cloud computing, and big data analytics can help organisations reduce resource consumption, improve energy efficiency, minimise waste and monitor environmental performance. The concept of **Green Intelligence** highlights that the value of digital transformation is not limited to technological advancement or operational efficiency; it also lies in its ability to support environmentally responsible business practices. However, successful execution relies on several key elements, including organisational preparedness, technological frameworks, staff capabilities, financial resources, leadership backing, data accessibility and an understanding of sustainable practices. Consequently, companies must embrace a well-rounded strategy that simultaneously advances both digital transformation and environmental sustainability. Green Intelligence can therefore become an important component of future business strategy and sustainable development.

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