

Environmental Impact of Digital Transformation in Modern Business

Author Name¹: **Ashwini M R,**

Second Author Name²: **Madhunayaka**

MBA Student Vidya Vikas Institute of engineering and technology, Mysuru

Assistant Professor, Vidya Vikas Institute of engineering and technology, Mysuru

ABSTRACT

Digital transformation has become a key driver of growth and innovation in modern businesses by integrating advanced technologies such as Artificial Intelligence (AI), Cloud Computing, the Internet of Things (IoT), Big Data Analytics, and automation into business operations. These technologies have improved operational efficiency, productivity, customer experience, and decision-making while also supporting environmental sustainability through paperless operations, remote working, smart resource management, and efficient monitoring of environmental performance. However, the rapid expansion of digital infrastructure has also raised environmental concerns, including increased electricity consumption, carbon emissions, electronic waste generation, and excessive use of natural resources. This study aims to examine the environmental impact of digital transformation in modern businesses by evaluating both its positive and negative effects on environmental sustainability. A descriptive research design was adopted, and primary data were collected from 62 respondents using a structured questionnaire through convenience sampling, while secondary data were gathered from journals, books, research articles, and published reports. The collected data were analyzed using descriptive statistics, Chi-square, ANOVA, and SPSS software. The findings indicate that most organizations have widely adopted cloud computing, digital documentation, automation, and hybrid working models, which have reduced paper consumption, improved resource utilization, and enhanced environmental monitoring. Respondents also agreed that digital technologies help organizations track sustainability performance and improve operational efficiency. At the same time, the study found that the increasing use of digital systems, cloud services, and data centers has significantly increased electricity consumption and contributes to environmental challenges such as carbon emissions and electronic waste. The study concludes that digital transformation has both beneficial and adverse environmental impacts and that sustainable digital practices are essential for achieving long-term environmental and business goals. Organizations should adopt Green Information Technology (Green IT), renewable energy sources, energy-efficient digital infrastructure, and effective e-waste management practices to maximize the environmental benefits of digital transformation while minimizing its ecological footprint. Such an approach will enable businesses to achieve sustainable growth and contribute to global environmental sustainability.

INTRODUCTION

Digital transformation refers to the integration of digital technologies into all sectors of business operations, where it fundamentally changing how organizations create value, deliver products and services, and interact with customers. Technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Big Data Analytics, and Cloud Computing which have enabled businesses to improve efficiency, enhance decision-making, and develop innovative business models.

In the modern business environment, digital transformation has become a strategic necessity rather than a competitive advantage alone. Organizations are adopting digital solutions to streamline operations, reduce costs, improve customer experiences, and respond more effectively to rapidly changing market conditions. The growing reliance on digital technologies has accelerated innovation, increased productivity, and facilitated global connectivity.

However, digital transformation also presents significant challenges. Businesses must address issues related to cybersecurity, data privacy, technological complexity, workforce adaptation, and the environmental impact of digital infrastructure. The increasing demand for data centers, electronic devices, and advanced computing systems has raised concerns about energy consumption, electronic waste, and resource depletion.

Despite these challenges, digital transformation continues to play a crucial role in shaping the future of modern business. Organizations that successfully embrace digital technologies can achieve sustainable growth, strengthen their

competitive position, and create long-term value for stakeholders. Therefore, understanding the opportunities, challenges, and implications of digital transformation is essential for businesses seeking success in the digital age.

Here, technologies enable organizations to improve operational efficiency, enhance customer experiences, increase productivity, and make data-driven decisions. As a result, digital transformation has become essential for businesses seeking to remain competitive in a rapidly evolving global economy.

The environmental impact of digital transformation is a growing area of concern and research. On one hand, digital technologies contribute positively to environmental sustainability by reducing paper consumption, optimizing supply chains, improving energy efficiency, and supporting smart resource management. Technologies such as IoT and AI help businesses monitor energy usage, reduce waste generation, and lower carbon emissions through intelligent decision-making systems.

On the other hand, the rapid expansion of digital infrastructure creates significant environmental challenges. Data centers, cloud computing facilities, and communication networks require large amounts of electricity and water for operation and cooling. The manufacturing of digital devices depends on the extraction of valuable natural resources such as lithium, cobalt, and rare earth metals. Furthermore, the increasing disposal of obsolete electronic devices contributes to the global e-waste problem, posing risks to both human health and the environment.

The environmental consequences of digital transformation therefore present a complex balance between sustainability benefits and ecological costs. While digital technologies can support greener business practices and contribute to sustainable development, their growing energy demands and resource requirements cannot be ignored. Businesses must adopt responsible digital strategies that promote innovation while minimizing environmental impacts.

In today's business environment, achieving a balance between digital advancement and environmental sustainability has become a critical challenge. Understanding the environmental impact of digital transformation is essential for organizations, policymakers, and stakeholders seeking to ensure that technological progress contributes to long-term economic growth without compromising environmental well-being.

REVIEW OF LITERATURE

Feroz, Zo, and Chiravuri (2021) In their article “**Digital Transformation and Environmental Sustainability: A Review and Research Agenda**” examined how digital technologies influence environmental sustainability. The authors found that digital transformation supports pollution control, waste management, sustainable production, and smart city development. They concluded that digital technologies can significantly contribute to environmental sustainability when properly managed. **Guandalini (2022)** In the article “**Sustainability through Digital Transformation: A Systematic Literature Review for Research Guidance**” explored the role of digital technologies in achieving sustainability. The study found that AI, IoT, and big data enhance resource management and operational efficiency while posing challenges related to energy consumption and electronic waste. **Charfeddine and Umlai (2023)** In their article “**ICT Sector, Digitization and Environmental Sustainability: A Systematic Review of the Literature from 2000–2022**” reviewed studies on digitalization and environmental performance. They concluded that digital technologies can reduce carbon emissions and improve energy efficiency, especially when supported by renewable energy sources. **Goel, Mazurka, and Pathade (2024)** in their article “**An Overview of Digital Transformation and Environmental Sustainability: Threats, Opportunities, and Solutions**” discussed both the positive and negative environmental impacts of digital transformation. The authors highlighted benefits such as smart cities and circular economy practices, while also identifying challenges including e-waste generation and increasing energy demand. • Smart Green World? Making Digitalization Work for Sustainability (2020) by Steffen Lange and Tilman Santarius explains how digital technologies affect environmental and social sustainability, highlighting both efficiency benefits and hidden environmental costs like energy use and consumption-driven impacts. “**The Palgrave Handbook of Corporate Sustainability in the Digital Era**”(2021) edited by Seung Ho Park, Maria Alejandra Gonzalez-Perez, and Dinora Eliete Floriani explores how digital transformation reshapes corporate sustainability strategies, including challenges such as emissions from digital infrastructure and opportunities like green innovation. “**Blockchain Technologies for Sustainability**” (2022) edited by **Subramanian Senthil Kannan Muthu** shows how blockchain can improve transparency, traceability, and efficiency in

supply chains, helping reduce environmental impact and support sustainable development goals. **“Digital Transformation for Sustainability: ICT-supported Environmental Socio-economic Development (2022) by Jorge Marx Gómez and Maria Rosa Lorini** examines how ICT and digital systems can support environmental sustainability through smart cities, data analytics, and resource optimization. **“Data-Driven Sustainability: Harnessing Technology for a Greener Future and Environmental Resilience” (2026) by Rubee Singh, Walter Leal Filho, and Vikas Kumar** discusses how big data and emerging digital technologies can be used to address environmental challenges and build climate resilience. **Green Swans (2020) by John Elkington** introduces the idea of “green swans,” explaining large-scale environmental risks and opportunities, including how digital innovation and system transformation can help address climate challenges. **“Net Positive” (2021) by Paul Polman and Andrew Winston** explains how businesses can go beyond reducing harm to actively creating environmental and social value, with digital tools playing a key role in measuring and improving impact. **“The Circular Economy Handbook” (2020) by Peter Lacy and colleagues** discusses how companies can redesign business models using digital technologies, data systems, and smart supply chains to reduce waste and improve resource efficiency.

STATEMENT OF THE PROBLEM

Despite the widespread institutional integration of digital transformation as a primary mechanism for achieving global sustainability targets, a critical paradox remains unresolved: the digital infrastructure designed to mitigate environmental degradation is itself becoming a primary driver of ecological strain. Current policy frameworks for the "twin transition" assume a linear, synergistic relationship where digital efficiency automatically yields net carbon reductions. However, this assumption fails to account for the material reality of contemporary technology. The transition to high-density computational models—particularly generative artificial intelligence, hyperscale cloud architecture, and widespread automation—has triggered an exponential surge in direct, first-order ecological costs. These costs manifest as unprecedented grid demands, high water consumption for server cooling, and accelerating electronic waste generation, all of which heavily rely on carbon-intensive energy sectors and finite raw materials.

NEED FOR THE STUDY

There is a significant implementation gap between corporate sustainability rhetoric and the actual, measurable reduction of carbon emissions. While many organizations publicly commit to environmental goals, their real-world progress often falls short, revealing structural, financial, and operational barriers that limit the execution of green strategies. In many cases, sustainability initiatives remain fragmented, poorly integrated into core business functions, or weakened by short-term profit pressures. At the same time, the digital–green convergence, often described as the “twin transition,” is an emerging field where digital transformation technologies such as AI, IoT, blockchain, and Big Data intersect with environmental sustainability efforts. These technologies have strong potential to improve environmental monitoring, enable predictive analytics, optimize supply chains, and reduce resource waste, but their actual environmental benefits depend heavily on implementation quality, infrastructure readiness, and energy consumption of digital systems themselves. This makes the relationship complex, as digitalization can both reduce and increase environmental impact depending on usage.

OBJECTIVE OF THE STUDY

- To analyze the role of digital technologies in improving environmental sustainability across industries.
- To examine the direct environmental impacts of digital transformation, including energy consumption and electronic waste generation.
- To evaluate the influence of rebound effects on the environmental outcomes of digital transformation.

HYPOTHESIS

Null Hypothesis (H_0):

Digital transformation has no significant impact on environmental sustainability. Any observed changes in resource efficiency or environmental impact are due to random variation or other external factors.

Alternative Hypothesis (H_1):

Digital transformation has a significant impact on environmental sustainability, influencing both positive outcomes (such as improved efficiency and reduced waste) and negative outcomes (such as increased energy consumption and electronic waste).

RESEARCH METHODOLOGY

Research Design: The study adopts a descriptive research design to examine the environmental impact of digital transformation in modern businesses. The research focuses on understanding employees' perceptions regarding the role of digital technologies in promoting environmental sustainability, energy consumption, electronic waste generation, and resource efficiency.

Research approach: the required information was collected through:

- Structured questionnaire
- Direct interaction with respondents

SOURCES OF DATA

Primary Source: Primary data were collected directly from 62 respondents using a structured questionnaire. The respondents were employees working in organizations that have adopted digital technologies, and convenience sampling was used for data collection.

Secondary Source: Secondary data were collected from various published sources, including research journals, books, articles, websites, and other published literature related to digital transformation and environmental sustainability.

Sampling Technique: A convenience sampling method was used to select respondents. Individuals working in organizations that have adopted digital technologies were chosen based on their accessibility and willingness to participate in the survey.

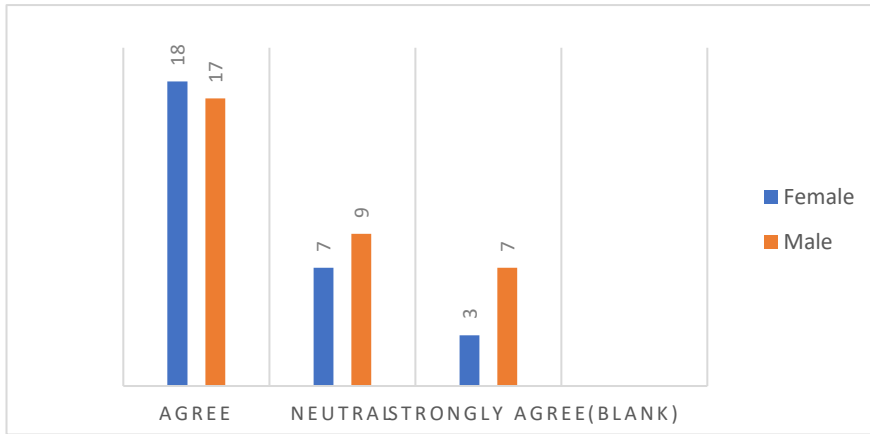
Sample Size: The study was conducted on a sample of 62 respondents. The respondents belonged to different age groups and genders, providing diverse perspectives on the environmental implications of digital transformation.

LIMITATION OF THE STUDY

- The study is limited to a sample size of 62 respondents.
- Responses are based on personal perceptions and may involve subjective bias.
- The research covers a specific geographical area and may not represent all industries or regions.
- Time and resource constraints limited the scope of data collection.

DATA ANALYSIS**1. Demographic question**

1. Age group					
	18-22	23-27	28-32	Above 32	Grand Total
Female	9.68%	14.52%	14.52%	6.45%	45.16%
Male	9.68%	27.42%	6.45%	11.29%	54.84%
Grand Total	19.35%	41.94%	20.97%	17.74%	100.00%



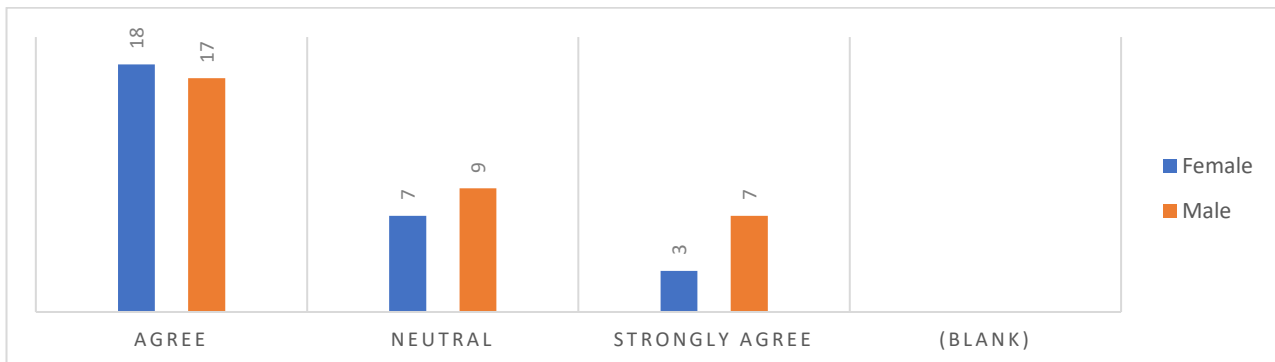
Analysis

The age distribution of respondents shows that 19.35% belong to the 18–22 years age group, 41.94% belong to the 23–27 years age group, 20.97% belong to the 28–32 years age group, and 17.74% are above 32 years of age. Out of the total respondents, 54.84% are male and 45.16% are female.

Interpretation

The majority of respondents belong to the 23–27 years age group. This indicates that the study is largely represented by young working professionals who are actively exposed to digital technologies and modern business practices, making their opinions relevant for assessing the environmental impact of digital transformation. The sample consists of a relatively balanced representation of both genders, although male respondents slightly outnumber female respondents. This helps in obtaining diverse viewpoints regarding digital transformation and environmental sustainability.

2. My company has moved most of its files and work online to the cloud.			
	Female	Male	Grand Total
Agree	22.58%	27.42%	50.00%
Disagree	4.84%	6.45%	11.29%
Neutral	11.29%	11.29%	22.58%
Strongly Agree	4.84%	9.68%	14.52%
Strongly disagree	1.61%	0.00%	1.61%
Grand Total	45.16%	54.84%	100.00%



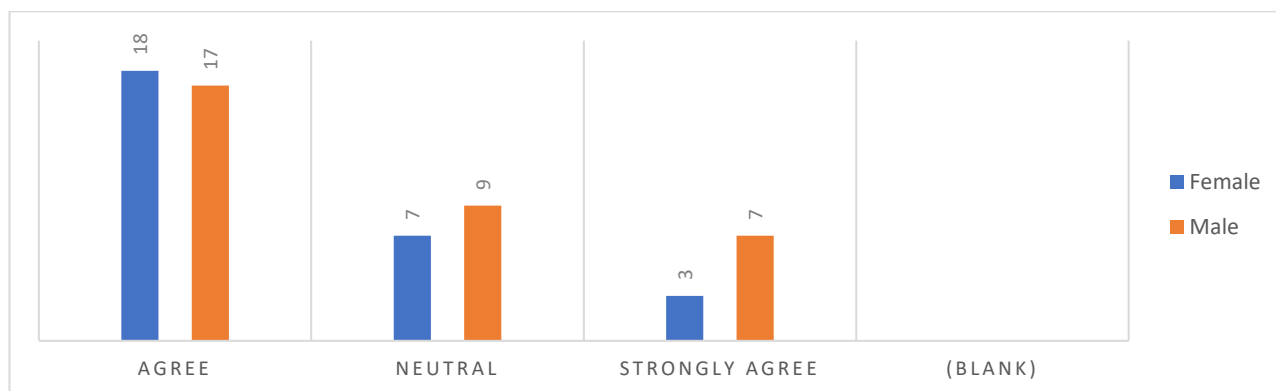
Analysis

Among the respondents, 50.00% agree that their company has moved most of its files and work online to the cloud, while 14.52% strongly agree. Further, 22.58% remain neutral, whereas 11.29% disagree and 1.61% strongly disagree.

Interpretation

The findings indicate that cloud computing has been widely adopted by organizations. The high percentage of agreement suggests that businesses are increasingly relying on digital platforms for storing information and managing operations, reflecting the growing trend of digital transformation.

3. Many employees now work from home or do hybrid work instead of coming to the office every day.			
	Female	Male	Grand Total
Agree	22.58%	19.35%	41.94%
Disagree	3.23%	6.45%	9.68%
Neutral	8.06%	11.29%	19.35%
Strongly agree	8.06%	17.74%	25.81%
Strongly disagree	3.23%	0.00%	3.23%
Grand Total	45.16%	54.84%	100.00%



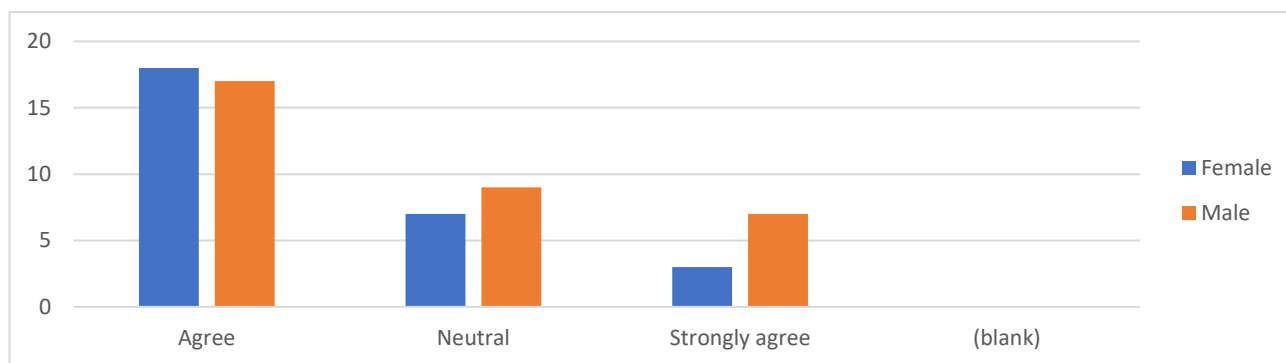
Analysis

The data reveal that 41.94% of respondents agree and 25.81% strongly agree that employees work remotely or follow hybrid working arrangements. Meanwhile, 19.35% remain neutral, 9.68% disagree, and 3.23% strongly disagree.

Interpretation

The results show that remote and hybrid work practices have become common in many organizations. This reflects the influence of digital technologies in enabling flexible work environments and reducing dependence on physical office spaces.

4. Using so many online systems and servers has actually increased our company's electricity use.			
	Female	Male	Grand Total
Agree	22.95%	29.51%	52.46%
Disagree	1.64%	4.92%	6.56%
Neutral	11.48%	8.20%	19.67%
Strongly agree	8.20%	13.11%	21.31%
Grand Total	44.26%	55.74%	100.00%



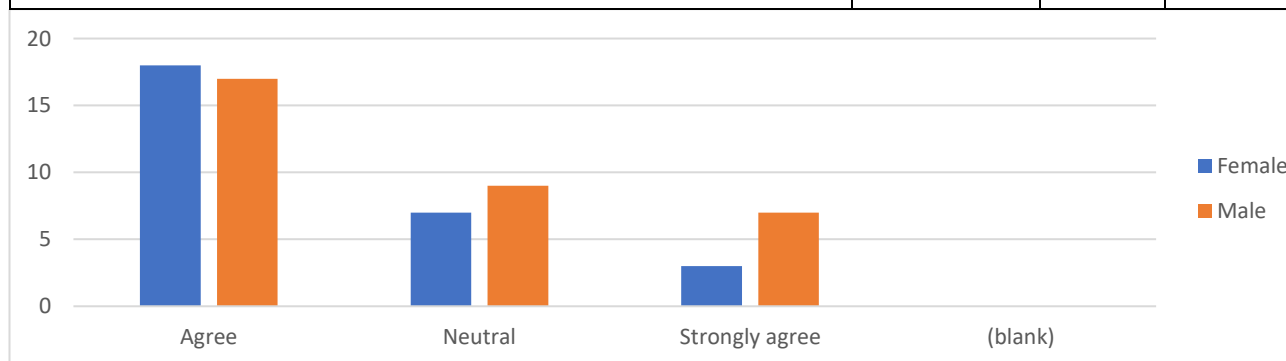
Analysis

The table shows that 52.46% of respondents agree and 21.31% strongly agree that the use of online systems and servers has increased their company's electricity consumption. In contrast, 19.67% are neutral and 6.56% disagree.

Interpretation

The majority of respondents believe that digital transformation contributes to higher electricity consumption. This suggests that while digital technologies improve operational efficiency, they also create environmental challenges through increased energy requirements for digital infrastructure and data centers.

5.Our new software systems make it simple to track and report how eco-friendly the company is.			
	Female	Male	Grand Total
Agree	29.51%	27.87%	57.38%
Neutral	11.48%	14.75%	26.23%
Strongly agree	4.92%	11.48%	16.39%
Grand Total	45.90%	54.10%	100.00%



Analysis

The data indicate that 57.38% of respondents agree and 16.39% strongly agree that new software systems help their organization track and report environmental performance. The remaining 26.23% are neutral, and no respondents disagree.

Interpretation

The findings demonstrate that digital technologies are perceived as effective tools for environmental monitoring and sustainability reporting. Organizations are increasingly using software systems to measure and manage their environmental performance, supporting sustainable business practices.

N PAR TEST

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
6. My company has moved most of its files and work online to the cloud.	62	1	5	3.60	.983
7. Many employees now work from home or do hybrid work instead of coming to the office every day.	62	1	5	3.77	1.047
8. We use computer programs to automate tasks instead of using paper forms.	62	2	5	4.11	.680
9. My company is actively trying to make its shipping and supply chain more modern and efficient.	62	1	5	3.76	.881
Valid N (listwise)	62				

SPSS TEST

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
12	The categories of 12. Because more people work from home, we have cut down on pollution from daily traffic/commuting. occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.
13	The categories of 13. Using so many online systems and servers has actually increased our company's electricity use. occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.
14	The categories of 14. Throwing away old office computers and tech is creating too much electronic waste (e-waste). occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.
15	The categories of 15. Our new software systems make it simple to track and report how eco-friendly the company is. occur with equal probabilities.	One-Sample Chi-Square Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

CHI-SQUARE TEST

15. Our new software systems make it simple to track and report how eco-friendly the company is.			
	Observed N	Expected N	Residual
2	1	15.5	-14.5
3	17	15.5	1.5
4	35	15.5	19.5
5	9	15.5	-6.5
Total	62		

7. Many employees now work from home or do hybrid work instead of coming to the office every day.			
	Observed N	Expected N	Residual
1	2	12.4	-10.4
2	6	12.4	-6.4
3	12	12.4	-.4
4	26	12.4	13.6
5	16	12.4	3.6
Total	62		

ANOVA

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.681	5	1.336	1.839	.120 ^b
	Residual	40.690	56	.727		
	Total	47.371	61			

FINDINGS

- The study found that most organizations have widely adopted digital technologies such as cloud computing, automation, and hybrid work practices, improving operational efficiency and reducing paper usage.
- A majority of respondents agreed that digital transformation helps organizations monitor and report environmental performance more effectively through digital tools.
- The findings also revealed that increased use of digital infrastructure, online systems, and data centers has significantly increased electricity consumption.
- Respondents recognized that digital transformation supports resource optimization and sustainable business practices, but it also contributes to environmental challenges such as electronic waste and carbon emissions.
- Overall, the study concludes that digital transformation has both positive and negative environmental impacts, highlighting the need for organizations to adopt sustainable digital practices to achieve long-term environmental and business sustainability.

CONCLUSION

The findings of this research indicate that digital transformation has fundamentally changed the way modern businesses operate. Organizations are increasingly adopting cloud computing, automation, artificial intelligence, digital documentation, and remote working practices to improve operational efficiency and business performance. These technologies contribute significantly to environmental sustainability by reducing paper consumption, optimizing supply chains, improving resource utilization, and supporting data-driven environmental monitoring.

However, the study also reveals that digital transformation is not entirely environmentally friendly. The growing demand for cloud services, data centers, artificial intelligence, and online platforms requires substantial electricity consumption, increasing greenhouse gas emissions where renewable energy sources are not utilized. Additionally, rapid technological advancements contribute to electronic waste generation and increased extraction of natural resources such as lithium, cobalt, and rare earth metals.

The research demonstrates that digital transformation creates both opportunities and challenges for environmental sustainability. While digital technologies enable organizations to achieve greater efficiency and reduce certain forms of environmental impact, they simultaneously introduce new ecological pressures that cannot be ignored.

The study therefore concludes that sustainable digital transformation requires a balanced approach in which organizations integrate environmental responsibility into every stage of digital adoption. Investment in renewable energy, energy-efficient technologies, circular economy practices, and responsible electronic waste management will enable businesses to maximize the environmental benefits of digital transformation while minimizing its negative consequences. In the future, organizations that successfully combine digital innovation with environmental sustainability will be better positioned to achieve long-term competitive advantage and sustainable growth.

SUGGESTIONS

- **Adopt Green IT Practices:** Organizations should implement energy-efficient digital technologies to reduce electricity consumption and minimize environmental impact.
- **Use Renewable Energy:** Businesses should power data centers and digital infrastructure with renewable energy sources such as solar and wind energy.
- **Improve E-waste Management:** Companies should establish proper recycling and disposal systems for obsolete electronic devices to reduce environmental pollution.
- **Promote Paperless Operations:** Organizations should encourage digital documentation, e-signatures, and online communication to reduce paper consumption.
- **Monitor Environmental Performance:** Businesses should use AI, IoT, and digital tools to track energy usage, carbon emissions, and resource consumption.
- **Conduct Employee Awareness Programs:** Regular training should be provided to educate employees about sustainable digital practices and environmental responsibility.
- **Strengthen Sustainable Digital Strategies:** Organizations should integrate environmental sustainability into their digital transformation plans to achieve long-term business growth and environmental protection.

Bibliography

- Feroz, A. K., Zo, H., & Chiravuri, A. (2021). Digital Transformation and Environmental Sustainability: A Review and Research Agenda.
- Guandalini, I. (2022). Sustainability through Digital Transformation: A Systematic Literature Review for Research Guidance.
- Charfeddine, L., & Umlai, M. (2023). ICT Sector, Digitization and Environmental Sustainability: A Systematic Review of the Literature from 2000–2022.
- Goel, P., Mazurka, R., & Pathade, A. (2024). An Overview of Digital Transformation and Environmental Sustainability: Threats, Opportunities, and Solutions.
- Lange, S., & Santarius, T. (2020). Smart Green World? Making Digitalization Work for Sustainability.
- Park, S. H., Gonzalez-Perez, M. A., & Floriani, D. E. (Eds.). (2021). The Palgrave Handbook of Corporate Sustainability in the Digital Era.
- Muthu, S. S. K. (Ed.). (2022). Blockchain Technologies for Sustainability.
- Gómez, J. M., & Lorini, M. R. (2022). Digital Transformation for Sustainability: ICT-Supported Environmental Socio-economic Development.
- Singh, R., Leal Filho, W., & Kumar, V. (2026). Data-Driven Sustainability: Harnessing Technology for a Greener Future and Environmental Resilience.
- Elkington, J. (2020). Green Swans.
- Polman, P., & Winston, A. (2021). Net Positive.
- Lacy, P., Long, J., & Spindler, W. (2020). The Circular Economy Handbook.