SANKARA
COLLEGE OF SCIENCE & COMMERCE
AN AUTONOMOUS INSTITUTION

NAAC
A+ GRADE

Book Chapters on
Indian Knowledge Systems and Sustainable Development in Business and Information Technology - A Diverse Perspective

Editors
Dr. R. Umadevi
Dr. K. Aruljothi
Dr. C. A. Anuradha

ISBN NUMBER
978-93-344-5330-0

Indian Knowledge Systems and Sustainable Development in Business and Information Technology – A Diverse Perspective

First Edition

EDITORS
Dr.R.Umadevi
Dr.C.A.Anuradha
Dr.K.Aruljothi

Published by

Sankara College of Science and Commerce (Autonomous)

Affiliated by Bharathiar University, Approved by AICTE, Accredited by NAAC A^{+} Grade,
An ISO 9001:2015 certified, Saravanampatty, Coimbatore - 641035, TamilNadu, India.
Phone:0422–4313500

www.sankara.ac.in

Edition: First

Year: December, **2025**

ISBN: 978-93-344-5330-0

MRP.500/-

Publisher

Sankara College of Science and Commerce (Autonomous)
Affiliated by Bharathiar University, Approved by AICTE Accredited
by NAAC A+ Grade, An ISO 9001:2015 certified Saravanampatty,
Coimbatore - 641035, TamilNadu, India.
Phone:0422-4313500
.www.sankara.ac.in

INDEX

Integrating Indian Knowledge Systems with Digital Circularity: A Sustainable Model for the Technology Sector

Dr N.Ponsabariraj[1], Dr Sridevi.S[2]

[1]Assistant Professor, Department of B.Com (E-Commerce), Nallamuthu Gounder Mahalingam College, Pollachi, Coimbatore

[2]Assistant Professor, Department of B.Com (Fin Tech), PSGR Krishnammal College for Women, Coimbatore

ABSTRACT

This study investigates the critical intersection between digital transformation and the circular economy in promoting sustainable business models within the technology sector. With growing concerns over environmental degradation, resource depletion, and electronic waste, firms are increasingly seeking ways to transition from linear "take–make–dispose" models to circular practices. The research focuses on how digital technologies, including Artificial Intelligence (AI), Internet of Things (IoT), blockchain, big data analytics, and cloud computing, facilitate recycling, remanufacturing, and resource optimization. A quantitative research design was adopted, involving 150 respondents selected through simple random sampling. Data were collected using structured questionnaires and analyzed using descriptive statistics to assess perceptions, and factor analysis to identify key dimensions of circular economy adoption. Results reveal that AI and IoT are the most influential technologies for enhancing efficiency and sustainability, while blockchain, big data, and cloud computing show moderate impact. Four major factors—operational efficiency, innovation capability, resource efficiency, and brand reputation—emerged as primary outcomes of circular adoption. The study highlights that integrating digital technologies with circular economy principles not only improves firm performance but also fosters sustainable innovation. Overall, the research emphasizes that a digitally enabled circular economy can drive long-term competitiveness, environmental sustainability, and green growth in the technology sector.

Keywords: Circular Economy, blockchain, big data.

INTRODUCTION

In recent years, the intersection of sustainability and technology has emerged as a central theme in global business transformation. The growing urgency of environmental challenges such as climate change, resource depletion, and electronic waste has compelled organizations to reimagine traditional linear models of "take–make–dispose." This has given rise to the circular economy (CE)—an economic framework aimed at minimizing waste, optimizing resource use, and regenerating natural systems through practices like recycling, remanufacturing, and reuse. At the same time, rapid digital transformation—driven by technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, big data analytics, and cloud computing—is reshaping how businesses operate, innovate, and deliver value.

The technology industry, while being an engine of innovation and growth, also contributes significantly to environmental degradation through high energy consumption, electronic waste, and short product life cycles. Integrating circular economy principles within this sector is therefore not only a strategic necessity but also a moral imperative for achieving sustainable development. Digital technologies provide the tools and intelligence needed to enable this transition—AI can optimize resource efficiency, IoT devices can track product lifecycles, blockchain can ensure supply-chain transparency, and big data analytics can support decision-making for sustainability. By embedding these digital solutions, technology-based firms can close material loops, reduce emissions, and foster circular innovation across production and consumption systems. Moreover, the fusion of circular economy and digital transformation has profound implications for business model innovation. It enables companies to shift from product ownership to service-based models, extend product life spans through predictive maintenance, and design eco-friendly solutions that enhance both profitability and environmental responsibility..

Despite its potential, the implementation of circular economy strategies through digital transformation remains limited, especially in developing economies where awareness, investment, and policy support are still evolving. Hence, there is a pressing need to explore how digital technologies facilitate circular practices and how these practices, in turn, impact organizational performance, innovation capability, and environmental sustainability in the technology-driven business environment. This study, therefore, aims to analyze the role of digital transformation in enabling circular economy practices and to evaluate its influence on sustainable business performance. By bridging the gap between digital innovation and sustainability, the research seeks to contribute to academic understanding and managerial practice in achieving green growth and long-term competitiveness within the technology sector.

1.1 REVIEW OF LITERATURE

Scholtysik, Rasor, Petzke, Koldewey, and Dumitrescu (2025) conducted a systematic literature review exploring how digital technologies support the implementation of circular economy (CE) principles. Their study emphasized that technologies such as artificial intelligence (AI), the Internet of Things (IoT), big data analytics, and block chain play a critical role in facilitating resource optimization, recycling, and remanufacturing across industries. The authors identified that digital transformation acts as a catalyst in enabling circular strategies such as slowing, narrowing, and closing material loops. However, the review also pointed out existing gaps—many firms lack clarity on how to effectively integrate specific technologies into their CE processes, which highlights the need for frameworks linking digital tools to circular value creation. This study aligns closely with the current research objective of assessing how digital technologies enable circular economy practices within the technology sector.

Khan, Piprani, and Yu (2022) examined the impact of digital technologies on circular economy practices in the context of small and medium enterprises (SMEs) in China and Pakistan. Their empirical analysis revealed that technological innovation positively influences the adoption of circular economy practices, which in turn enhances firms' financial and environmental performance. The study established that firms investing in digital solutions are more likely to engage in recycling, remanufacturing, and resource-efficient operations. Furthermore, the results confirmed that circular economy practices serve as a mediating factor between digital innovation and organizational success. The research contributes to understanding how circular economy adoption enhances both innovation potential and sustainability outcomes, aligning with the objective of evaluating the influence of CE on organizational performance in the technology-driven business environment.

A multiple case study published in **Resources, Conservation and Recycling (2021)** investigated the role of digital technologies in driving business model innovation for the circular economy. The study analyzed several technology-oriented firms across Northern Europe and found that digitalization not only improves operational efficiency but also transforms how firms create, deliver, and capture value. Technologies such as data analytics and integration platforms were found to enhance transparency in resource use, enabling the development of circular business models centered on reuse, recycling, and remanufacturing.

The findings demonstrate that digital technologies act as both enablers and catalysts for circular innovation, supporting the transition toward sustainable business models. This research provides strong evidence for understanding how digital transformation contributes to circular practices and overall organizational innovation capability.

1.2 STATEMENT OF THE PROBLEM

The technology sector, while being a driving force of innovation and global economic growth, increasingly faces challenges associated with environmental degradation, energy consumption, and electronic waste generation. The prevailing linear model of production and consumption—based on the "take–make–dispose" approach—has become unsustainable amid rising concerns about resource depletion and climate change. To address these challenges, the adoption of circular economy (CE) principles that promote resource efficiency, recycling, and product life-cycle extension has become imperative. Simultaneously, digital transformation powered by technologies such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, big data analytics, and cloud computing offers powerful tools to operationalize these CE practices by enabling resource optimization, process transparency, and sustainable innovation. However, despite the potential synergy between digital transformation and the circular economy, most technology-driven organizations struggle to integrate these concepts effectively within their business models. Empirical evidence on how digital technologies enable circular practices and their subsequent impact on organizational performance, innovation capability, and environmental sustainability remains limited. This lack of integrated understanding hinders the development of sustainable and competitive business strategies in the technology sector. Therefore, there is a pressing need to investigate how digital transformation can act as a catalyst for circular economy implementation and how this integration can unlock sustainable business models in the technology-driven era.

1.3 RESEARCH QUESTIONS

- How do digital technologies such as AI, IoT, blockchain, big data analytics, and cloud computing facilitate the adoption of circular economy practices in the technology sector
- How does the adoption of circular economy practices impact organizational performance in technology firms

1.4 OBJECTIVES OF THE STUDY

- To examine how digital technologies such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, big data analytics, and cloud computing contribute to the implementation of circular economy practices, including recycling, remanufacturing, and resource optimization within the technology sector.
- To evaluate the influence of circular economy adoption on firms' organizational performance, innovation potential, and overall environmental sustainability in the technology-driven business environment.

1.5 LIMITATIONS OF THE STUDY

The present study on "Circular Economy and Digital Transformation: Unlocking Sustainable Business Models in the Technology Sector" has certain limitations. The research is confined to the technology sector, restricting the generalizability of findings to other industries. Data availability poses a challenge, as organizations may be reluctant to share detailed information on digital adoption and circular economy practices. The diverse nature of technologies such as AI, IoT, blockchain, and cloud computing makes it difficult to isolate their individual effects. Measurement of abstract variables like innovation and sustainability may involve subjective interpretation. Moreover, the rapid pace of technological change may render the findings time-bound. Geographical and contextual factors may also limit applicability across regions. Respondent bias in surveys or interviews could affect the reliability of results. The study primarily identifies relationships rather than causal links. External environmental and policy factors are not fully considered, and finally, time and resource constraints may have restricted the depth of analysis.

1.6 RESEARCH METHODOLOGY

The study followed a quantitative research design to analyze how digital technologies contribute to circular economy practices and their influence on firm performance. A total of 150 respondents from the technology sector were selected using the simple random sampling method to ensure fairness and representativeness. Primary data were collected through a structured questionnaire using a five-point Likert scale to measure perceptions of technologies such as AI, IoT, blockchain, big data, and cloud computing in promoting recycling, remanufacturing, and resource optimization. The tool underwent expert validation and pilot testing to ensure reliability and clarity. The collected data were analyzed using descriptive statistics to determine mean, standard deviation, and variability of responses. Further, factor analysis was applied to identify the key dimensions influencing circular economy adoption on firm performance. The Kaiser-Meyer-Olkin (KMO) value and Bartlett's Test of Sphericity confirmed the suitability of the data for factor analysis. Statistical software such as SPSS was used for computation and interpretation. Ethical considerations, including confidentiality and voluntary participation, were maintained throughout the research process.

1.7 ANALYSIS AND INTERPRETATION

DESCRIPTIVE STATISTICS

Digital technologies such as Artificial Intelligence (AI), Internet of Things (IoT), block chain, big data analytics, and cloud computing contribute to the implementation of circular economy practices, including recycling, remanufacturing, and resource optimization within the technology sector.

The mean ratings of the agreement level of the respondents have been assigned as I for 'Not beneficial at all', 2 for 'not very beneficial', 3 for 'Somewhat beneficial', 4 for 'beneficial' and 5 for 'very beneficial'. The mean ratings have been found out for each item and are given in the following table.

Table: 1.1: Digital technologies and resource optimization within the technology sector

Impact	N	Min	Max	Mean	Std. Deviation
AI-enabled process optimization	150	1	5	4.4538	.76802
IoT-based monitoring systems	150	1	5	4.3576	.58500
Blockchain transparency	150	1	5	3.8929	.88533
Big data analytics for waste reduction	150	1	5	3.7143	1.03962
Cloud-based collaboration platforms	150	1	5	3.5738	1.15825
Digital product lifecycle management	150	1	5	3.7619	1.07952
Smart manufacturing integration	150	1	5	3.8529	.87533
Resource optimization systems	150	1	5	3.7143	1.03962
Recycling process	150	1	5	3.6738	1.09825

automation					
Technology-driven circular innovation	150	1	5	3.8929	.88533

Source : Primary data

The analysis of digital technologies and resource optimization within the technology sector reveals that AI-enabled process optimization has the highest mean score of 4.4538, indicating strong agreement and consistency among respondents regarding its positive impact on efficiency. IoT-based monitoring systems follow closely with a mean of 4.3576, showing that IoT is also highly valued for improving operational control and minimizing waste. In contrast, cloud-based collaboration platforms recorded the lowest mean score of 3.5738, reflecting moderate agreement and greater variation in opinions about their effectiveness. The findings suggest that AI and IoT play a crucial role in driving resource optimization and sustainable practices, while technologies like blockchain, big data, and cloud computing still show scope for stronger integration. Overall, digital transformation appears to be a key enabler of circular economy practices in the technology sector.

FACTOR ANALYSIS

Factor analysis is a statistical method used to identify underlying latent factors that explain the observed correlations among a set of variables. It is commonly employed to reduce the complexity of data and identify the essential dimensions that contribute to the variation in the data.

KMO and Bartlett's Test

To identify the satisfaction of the students towards Tamil Pudhalvan Scheme, factor analysis is employed. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity has been used as pre-analysis testing for suitability of the entire sample for factor analysis. The result of KMO and Bartlett's Test is found greater than 0.70. Hence, the collected data is fit for employing factor analysis. Further, the large values of Bartlett's sphericity test (354.56, df: 28, Sig=0.000) and KMO statistics (0.726) indicated the appropriateness of factor analysis i.e., the sample was adequate.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.726
Bartlett's Test of Sphericity	Approx. Chi-Square	354.56
	df	28
	Sig.	.000

Table 1.2: The Influence of Circular Economy Adoption On Firms

Statement	1	2	3	4
Operational efficiency	.793			
Financial performance	.604			
Innovation capability		.643		
Environmental performance		.610		
Resource efficiency			.787	
Customer satisfaction and perception			.507	
Brand image and reputation				.881
Employee engagement in sustainability				
Eigen Values	1.309	1.105	1.080	1.006
% of Variance	16.366	13.809	13.496	12.573
Cumulative % of Variance	16.366	30.176	43.671	56.244

The table presents the results of a factor analysis conducted to determine the key dimensions influencing the impact of circular economy adoption on firms within the technology sector. The Kaiser-Meyer-Olkin (KMO) value of 0.726 indicates a satisfactory level of sampling adequacy, while Bartlett's Test of Sphericity ($\chi^2 = 354.56$, $p < 0.001$) confirms the suitability of the data for factor analysis. Four distinct factors were extracted with eigenvalues greater than one, explaining a cumulative variance of 56.24%, which is acceptable in social science research. The first factor, contributing 16.37% of the variance, is associated with operational efficiency and financial performance, highlighting the economic and productivity-related benefits of circular economy practices. The second factor, explaining 13.81% of the variance, includes innovation capability and environmental performance, emphasizing the link between sustainability initiatives and innovative potential. The third factor, accounting for 13.50% of the variance, comprises resource efficiency and customer satisfaction, underscoring the role of optimized resource use in improving stakeholder perceptions. The fourth factor, contributing 12.57% of the variance, represents brand image and reputation, illustrating how circular economy adoption enhances corporate identity and sustainability branding. All factor loadings exceeded 0.5, confirming strong internal consistency and reliability of the identified dimensions.

1.8 FINDINGS OF THE STUDY

The descriptive statistics reveal that respondents perceive digital technologies as highly influential in promoting circular economy practices within the technology sector. AI-enabled process optimization received the highest mean score of 4.4538, showing strong agreement on its role in improving operational efficiency and resource use. IoT-based monitoring systems also ranked high with a mean of 4.3576, emphasizing their importance in tracking, monitoring, and reducing resource wastage. In contrast, cloud-based collaboration platforms recorded the lowest mean of 3.5738, indicating moderate agreement on their effectiveness. The results suggest that AI and IoT are leading enablers of sustainability and circular practices, while technologies like block chain, big data, and cloud computing still need deeper integration. Overall, respondents acknowledge digital transformation as a key driver of recycling, remanufacturing, and resource optimization.

The factor analysis identified four major dimensions influencing the impact of circular economy adoption on firms. The KMO value of 0.726 and Bartlett's Test of Sphericity (χ^2 = 354.56, $p < 0.001$) confirmed that the data was suitable for factor analysis. The four extracted factors explained a cumulative variance of 56.24%, which is acceptable for social science research. The first factor related to operational efficiency and financial performance, highlighting improved productivity and profitability. The second factor emphasized innovation capability and environmental performance, showing how sustainability fosters innovation. The third factor represented resource efficiency and customer satisfaction, linking efficiency with stakeholder trust. Finally, the fourth factor, brand image and reputation,

1.9 POLICY FOR IMPLICATIONS

The study's findings highlight the need for policies that strengthen the integration of digital technologies with circular economy initiatives in the technology sector. The strong influence of AI and IoT on resource optimization indicates that policymakers should promote greater investment in digital innovation and smart manufacturing systems to enhance operational efficiency and sustainability. Incentive-based policies such as tax benefits, subsidies, and grants can encourage firms to adopt advanced technologies that support recycling and waste reduction. As block chain, big data analytics, and cloud computing show moderate impact, government-led training, awareness, and digital skill development programs are essential to improve their utilization. Collaboration between public institutions and private firms should be encouraged to foster innovation and sustainable digital ecosystems. Moreover, regulatory frameworks and environmental standards should ensure transparency, accountability, and measurable sustainability outcomes.

CONCLUSION

The study concludes that digital technologies significantly contribute to promoting circular economy practices within the technology sector. The findings reveal that Artificial Intelligence (AI) and the Internet of Things (IoT) are the most impactful tools in enhancing efficiency, minimizing waste, and optimizing resource utilization. In contrast, blockchain, big data analytics, and cloud computing show moderate influence, indicating the need for wider adoption and integration. The factor analysis further demonstrates that circular economy adoption improves operational performance, innovation capability, environmental sustainability, and brand reputation among firms. These results suggest that digital transformation acts as a key driver of sustainable industrial growth. Policymakers should therefore focus on promoting digital infrastructure, capacity building, and incentive schemes to encourage technology-led sustainability. Strengthening public–private partnerships can accelerate innovation and support green transitions. Moreover, robust regulatory frameworks are essential to ensure accountability and measurable sustainability outcomes. Overall, the study emphasizes that integrating digital technologies with circular economy principles can create a more efficient, responsible, and future-ready technology sector.

REFERENCES

- *Scholtysik, M., Rasor, A., Petzke, L., Koldewey, C., & Dumitrescu, R. (2025). An integrative perspective on digital technologies and circular economy: A systematic literature review. Proceedings of the Design Society.*
- *Digital technologies catalyzing business model innovation for circular economy—Multiple case study. (2021). Resources, Conservation and Recycling, 164, 105155.*
- *Khan, S. A. R., Piprani, A. Z., & Yu, Z. (2022). Digital technology and circular economy practices: Future of supply chains. Operations Management Research, 15(3), 676-688.*

*****