

Circular Economy: Implications of Digitalisation Policy on Logistics and Supply Chain Management in Lagos Metropolis

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Abstract

Lagos, Nigeria, is an excellent example of a thriving economy grappling with waste management challenges. A circular economy digitization policy offers a unique opportunity to address these concerns while also revolutionizing logistics and supply chain management. This book chapter examined the nexus between digitalization of the circular economy and implications for logistics and supply chain management in Lagos State, Nigeria. The chapter employed the interpretivism philosophy and qualitative approach to data collection and analysis. Primary data were generated mainly through key informant interviews, and secondary data were gathered from the internet, journals, newspaper editorials, and other government publications on waste management policy. Directors and Deputy Directors in the Lagos State Ministry of Environment, the Lagos Waste Management Authority (LAWMA), and private sector participation (PSP) in waste collection and transportation were the subjects of key informant interviews. The content analytic approach was used in analyzing the collected data. Findings of the study revealed that Lagos State is currently working on building waste management optimization. It further revealed that digital tools would optimize waste collection routes and identify opportunities for material recovery, transforming waste into valuable resources for new products. The study concludes that circular economy practices unlock new opportunities for businesses in Lagos. Repair and remanufacturing sectors can thrive, generating employment and economic growth. The chapter recommended that the government should create an enabling environment by investing in infrastructure, promoting digital literacy, and fostering innovation in the circular economy space. However, the state needs to incentivize digital adoption and invest in skills development to facilitate collaboration among businesses that will promote knowledge sharing and develop best practices. The chapter contributed by filling gaps in literature, conceptual knowledge, and methodological gaps.

Keywords: *Circular Economy, Smart Technologies, Digitalization, Waste Management, Logistics and Supply Chains*

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Background to the Study

Lagos State, Nigeria, with its huge and rising population, has the opportunity to significantly benefit from a digitalization policy that promotes the circular economy in logistics and supply chain management (Olukanni et al., 2018). This has the potential to transform its supply chains towards a more sustainable and resource-efficient future. Digitalization policies seamlessly improve resource efficiency and product lifecycles, complementing digital tools that enhance transparency and optimize operations (Nwosu & Chukwueloka, 2020). Digitization policy is a collaborative effort involving the government, private sector, and civil society, as the combined effects of digitalization and circularity have enormous potential for economic growth, job creation, and environmental protection in Lagos State. It is undeniable that the circular economy, through the digitalization of its logistics and supply chain management, offers significant environmental and economic benefits (Ashade et al., 2023; Ezeudu, et al., 2021). It is instructive to note that integrating these two concepts presents some unique challenges, such as infrastructure limitations like unreliable internet connectivity and consistent power supply, which are essential for digital solutions. These limitations hinder real-time data collection, tracking, and overall system functionality. Therefore, studies (such as Oh & Hettiarachchi, 2020; Nwosu & Chukwueloka, 2020; and Oyelola et al., 2017) have noted that smaller circular economy businesses operating in the state lack the resources and skills to implement digital technologies. The challenges of informal waste collection systems, infrastructure limitations for waste sorting and processing facilities, and potentially higher costs compared to traditional linear systems are imminent, which create an uneven playing field and hinder logistics companies, waste management firms, and technology providers from accelerating innovation and developing cost-effective digital solutions for circular supply chains. Hence, the state has realized the need to address infrastructure, data management, skills development, collaboration, and policy alignment as concerns. This is a knowledge gap that this current study seeks to fill. As a result, the study underscores the need to examine the nexus between the digitalization of the circular economy and the implications on logistics and supply chain management in Lagos State, Nigeria.

This study is premised on the circular economy digitalization policy and its implications on logistics and supply chain management in Lagos State, Nigeria. This study is critical because it promotes waste management practices by enabling smart waste collection, recycling optimization, and identifying possible waste-to-resource conversion opportunities. As a result, the study uses digital technologies to improve waste segregation, recycling efficiency, and innovative recycling processes. However, investment in digital infrastructure, public-private partnerships, and awareness campaigns are necessary to overcome implementation challenges in Lagos State, Nigeria.

Literature Review

In this section, a review of previous studies was conducted, and an attempt was made to discuss the conceptual review, which included digitalization policy, circular economy, smart waste collection, recycling optimization, waste segregation, recycling efficiency, and innovative recycling processes. The section also discussed the theoretical framework, and the study was anchored on the waste-to-resource conversion theory.

Theoretical background and Review of literature

Conceptual Review: Digitization, Digitization Policy, and Circular Economy

Digitization is the process of converting analog information (physical objects, paper documents) into digital form (electronic data, computer files). It's the cornerstone of the digital revolution, transforming the way we interact, access information, and conduct business. Oyelola et al. (2017) view digitization as the process of converting physical data into digital formats by effective storage and management of large volumes of digital information. One of the fundamental characteristics of digitization is the ability to swiftly and easily share and transmit digital data, as well as use digital tools to analyze and derive insights from data.

A digitization policy explains a government's approach to embracing digital change. This policy influences infrastructure development, e-government and e-services, cybersecurity, and digital inclusion (Ghiatmedi, et al., 2020). It is instructive to note that investment in broadband networks, data centers, and digital literacy courses helps to bridge the digital divide by ensuring that all citizens have equal access to technology and skills. Nwosu & Chukwueloka (2020) define digitization policy as the implementation of measures to secure digital systems and data from cyber threats, as well as the shifting of government services online for enhanced efficiency and accessibility. The circular economy is an economic concept that seeks to reduce waste and pollution by keeping products and resources in use for as long as possible. Kehinde et al. (2020) defined the 4Rs as the main principles of the circular economy: reduce, reuse, recycle, and recover. These principles help in the development of more resource-efficient and long-lasting products. It increases product lifespan through repair, refurbishment, and resale (Okafor et al., 2020). It also extracts valuable resources from waste materials for future use and reprocesses materials from end-of-life products into new ones.

The conceptual links between digitization, digitization policy, and the circular economy emphasize the potential for synergistic approaches that leverage digital technology to achieve more sustainable and resource-efficient development results. It can be argued that circular economies drive the demand for digitalization since efficient tracking, monitoring, and optimization of material flows necessitates strong digital infrastructure and data management skills. Digitization allows and supports the adoption of circular economy principles by facilitating data-driven decision-making, innovative business models, and efficient resource management. Digitization policies embrace circular economy ideas, promoting the use of digital technology to address environmental concerns, foster sustainable production and consumption patterns, and transition to a more resource-efficient and regenerative economic model. It is an effective instrument for promoting a more sustainable future and a resource-conscious economic system.

Digitalization Policy Towards a Circular Economy

Digitalization policies are critical in promoting the circular economy by enabling the use of digital technology to optimize resource consumption, minimize waste, and encourage recycling. This policy aims to enhance waste management systems by leveraging digital technology and data analytics to optimize recycling and waste processing operations

(Olukanni et al., 2018). Nwosu & Chukwueloka (2020) define the circular economy as a model that attempts to keep resources in use for as long as possible, extracting maximum value before recovering and regenerating products and materials at the end of their service life. According to Ezeudu et al. (2021), the circular economy aims to design for reuse, repair, and recycling with extended producer responsibility, hence promoting industrial symbiosis and byproduct reuse. This will improve the collecting and processing infrastructure for end-of-life products. It can be argued that digitization is an enabler for smart waste collection systems. This system generates data on waste composition, volume, and location, allowing for improved resource management. In Lagos State, for example, businesses are deploying smart waste collection systems that use sensors, real-time data analytics, and IoT to optimize waste collection schedules and routes, reducing fuel usage while also enabling more effective recycling.

Little extant literature reveals that there is a growing body of evidence supporting the use of digital technology to promote the circular economy and improve recycling efficiency in Nigeria. The policy implications of digitalization policy should focus on continuous sensitization, training, and education for stakeholders on how to use digital tools and data infrastructure to provide robust database systems for waste management by developing digital platforms for citizens to report issues, access information, and engage with waste services.

Waste Segregation and Recycling Optimization

Waste segregation improves recycling efficiency by separating waste into different categories and helps waste generators with recycling facilities and businesses that utilize recycled materials to ensure that each type of waste is recycled most efficiently and effectively possible (Oh & Hettiarachchi, 2020). Effective waste segregation at the source, such as a separate collection of recyclables, organic, and residual waste, is critical for effective downstream processing and recycling. Optimization techniques include enhancing citizen awareness and participation in source segregation, optimizing collection routes and schedules, and improving processes at material recovery facilities (Ashade et al., 2023; Bressanelli et al., 2018). Tracking waste from source to final disposal or recycling allows for process improvement. Recycling optimization is possible via the application of digital technologies like machine learning and artificial intelligence, which may be used to streamline recycling operations and increase recycling efficiency.

Innovative Recycling Processes

Digital technology can also enable innovative recycling procedures, which are chemical or biological ways of separating waste into its component elements. These techniques help to improve recycling efficiency and minimize waste while also creating new business opportunities and revenue streams (Ghiatmedi et al., 2020). According to Olukanni et al. (2018), innovative recycling technologies improve the efficiency, quality, and range of materials that can be recycled by employing advanced sorting and separation techniques (e.g., optical sorting, robotics), chemical recycling methods for plastics, biological processing of organic waste (e.g., composting, anaerobic digestion), and waste upcycling into higher-value products.

Digitalisation Policy and the Circular Economy in Lagos State, Nigeria

Lagos State's digitalization policy for the circular economy focuses on creating a comprehensive ecosystem that enables data-driven decision-making, streamlined waste management, market-based incentives, and capacity-building to accelerate the transition toward a more sustainable and resource-efficient economy (Ashade et al., 2023). Hence, it is germane to consider below how the digitalization policy promotes a circular economy in the state.

Digital Waste Management and Smart Recycling Hubs Platform: The Lagos State government has launched a comprehensive digital platform in 2023 to manage waste collection, recycling, and disposal in the state. The state has established several smart recycling hubs that are linked to the digital waste management platform. These hubs employ digital technologies such as RFID, barcode scanning, and mobile apps to encourage citizen participation in recycling operations and monitor material flows. This platform optimizes waste logistics, tracks waste streams, and promotes recycling by leveraging smart sensors, IoT devices, and AI-powered analytics.

Circular Economy Data Analytics and Marketplace: Lagos State has built a digital marketplace that connects businesses, entrepreneurs, and citizens to facilitate the trading of secondary materials, byproducts, and unused assets, otherwise known as the *tokunbo space*. The state government has invested in developing robust data collection and analytics capabilities to monitor the performance of the circular economy initiatives. This involves using geospatial data, supply chain tracking, and predictive modeling to discover opportunities for improvement and optimization. The blockchain technology used on this platform ensures transaction transparency and traceability. The state has established a regulatory sandbox that allows businesses and startups to test and pilot innovative circular economy solutions, leveraging digital technologies, with reduced regulatory barriers. This aims to foster the development and adoption of new circular economy business models.

Circular Economy Awareness Campaign and Digital Skills Development: Recognizing the essence of digital literacy, the state government has launched training programs to equip small and medium-sized enterprises (SMEs), informal sector workers, and citizens with the necessary digital skills to participate in the circular economy to create job opportunities in the state. Also, the government has launched a comprehensive digital awareness campaign to educate Lagosians about the benefits of the circular economy and the role of digitalization in driving this transition. This includes the use of social media, online resources, and interactive platforms.

Digitalization Policy of the Circular Economy on Supply Chain Practices in Lagos State, Nigeria

Digitalization policy within Lagos' circular economy framework has had a significantly positive impact on Lagos state supply chain practices. Oyelola et al. (2017) argued that Lagos is seen as a prime example of how digital technologies have enabled the transition to a more circular and resource-efficient economy through increased visibility, optimization, and collaboration, resulting in cost, quality, and sustainability metrics.

Visibility and Traceability: The digital waste management platform and circular economy marketplace use technologies such as IoT, RFID, and blockchain to increase supply chain visibility (Okafor et al., 2020). This enables more accurate tracking of material flows, identification of waste streams, and traceability of secondary materials. Salami et al, (2018) alluded that the digitization initiatives have resulted in extensive use of technology like RFID, barcoding, and IoT sensors in manufacturing, warehousing, and transportation sectors. This has significantly improved supply chain visibility and the capacity to track the movement and status of materials, components, and finished goods. Improved visibility may also help businesses optimize their supply chains and identify opportunities for circularity.

Inventory Management: Real-time data from digital technologies has enabled Lagos businesses to optimize inventory levels, eliminate waste and spoilage, and more efficiently match supply and demand. The circular economy projects' robust data collection and analytics capabilities give businesses valuable insights to make more informed decisions about their supply chain operations. This includes identifying opportunities for waste reduction, material substitution, and process optimization. This has resulted in cheaper costs and better service delivery.

Reverse Logistics: The focus on the circular economy has led to investments in digital platforms and infrastructure that enable the collection, inspection, and reprocessing of used products and materials (Ofori & Mensah, 2022). The digital marketplace for secondary materials and byproducts facilitates the exchange of these resources among businesses, hence promoting circular sourcing practices. This can assist organizations in identifying and accessing alternative, more sustainable inputs for their supply chains, reducing their dependency on virgin materials. As a result, Lagos is experiencing an increase in product reuse, refurbishing, and recycling.

Transportation and Distribution: Digital route optimization, fleet management, and delivery scheduling have improved logistics operations in Lagos. It can be argued that better utilization of transport assets has resulted in lower emissions and fuel usage. The integration of smart sensors and AI-powered analytics into the digital waste management platform enables the optimization of waste collection, transportation, and recycling logistics (Salami et al., 2018). This has resulted in more effective waste management, higher recycling rates, and less waste leakage across the supply chain.

Collaboration and Information Sharing: Cloud-based supply chain management systems have facilitated better data interchange and coordination among Lagos manufacturers, distributors, retailers, and logistics providers. This has reduced conflicts, delays, and inefficiencies. The regulatory sandbox for circular economy solutions, as well as digital skills development initiatives, fosters collaboration and information sharing across supply chain actors, including SMEs and informal sector participants. This can result in the development of more innovative circular supply chain practices, as the adoption of these technologies in the circular economy marketplace enhances the transparency and traceability of supply chain transactions, promoting accountability and trust among supply chain partners.

Waste-to-Resource Conversion Theory

The study is situated around the waste-to-resource conversion theory. This theory focuses on maximizing the recovery and reuse of materials from waste streams by circular economy principles. The waste-to-resource conversion theory contends that waste may be seen as a valuable resource rather than a liability and that waste can be transformed into new products and services (Ashade et al., 2023; Tsai et al., 2020). Digitalization policy and circular economy principles can help to facilitate this transition by promoting the use of digital technology to optimize resource use and reduce waste, while also opening up new business opportunities and revenue streams.

Meanwhile, theory has helped to address the potential for waste-to-resource conversion in Lagos State. Lagos is home to various industries, including manufacturing, textiles, oil, and gas. There is potential to discover and use industrial byproducts and waste streams as inputs for other industries or processes, such as utilizing industrial sludge or wastewater to produce biogas (Kehinde et al., 2020). The state has generated a significant amount of organic waste from households, marketplaces, and food processing industries. This opens up opportunities for large-scale composting or anaerobic digestion to generate fertilizer and biogas (Tamasiga et al., 2022). Agricultural waste, such as cassava peels, palm kernel shells, and rice husks, could be used to produce biofuel or as a feedstock for manufacturing materials. It is evident that as a major economic and commercial hub, Lagos generates a significant amount of e-waste from discarded gadgets and electrical appliances. Developing formal e-waste recycling and recovery infrastructure might provide valuable materials such as metals and rare earth elements.

In addition, plastic waste is a major challenge in Lagos, with most of it ending up in rivers and the ocean. Establishing effective plastic waste collection and recycling systems could enable plastics to be converted into new products or fuels. Pyrolysis and gasification technologies could potentially be explored to convert plastic waste into lucrative hydrocarbon products (Okafor et al., 2020). The rapid urbanization and development in Lagos generate a significant amount of construction and demolition debris. Establishing efficient sorting and recycling methods could divert these materials from landfills and enable their reuse in new construction projects (Salami et al., 2018). Moreover, Lagos' huge and rising population generates a significant volume of municipal solid waste. Implementing comprehensive waste management systems, including waste-to-energy or waste-to-resource conversion technology, could help divert waste from landfills while also generating valuable resources. It can be argued that for these opportunities to be fully realized, Lagos would need to continue to invest heavily in waste management infrastructure, establish effective collection and sorting systems, and create an enabling policy and regulatory environment that encourages waste-to-resource conversion. Partnerships with the corporate body, academia, and international organizations could also play a critical role in designing and implementing sustainable waste management solutions tailored to the local context. However, there are also challenges to be addressed that limit the theory's applications.

Methodology

The study employed the interpretivism philosophy to data collection and analysis. Primary data were generated mainly through key informant interviews, as this approach combined case studies with semi-structured interviews. Case studies have been shown to provide accurate and sufficient data to understand complex situations as a rational chain of evidence from actual occurrences is created for critical and in-depth analysis. Secondary data were gathered from the internet, journals, newspaper editorials, and other government publications on waste management policy. Directors and Deputy Directors in the Lagos State Ministry of Environment, Lagos Waste Management Authority (LAWMA), and private sector participation (PSP) in waste collection and transportation were the subjects of key informant interviews (KII). The content analytic approach was used in analyzing the collected data. This study employed KII supported by a qualitative approach to provide clarity on smart waste collection, recycling optimization, waste segregation, and innovative recycling processes. The data gathering instrument used was semi-structured interviews using an interview guide and a double sampling technique consisting of judgment and convenience. The survey technique was chosen for its suitability to the research design, scale of operations, economic nature, locations, depth of accessible information, and a stated commitment to sustainability (Sallies et al., 2021). The study's validity was measured using both construct validity and content validity. While construct validity was designed in line with the convergent and discriminant views of earlier studies, content validity was tested among experts in circular economy, logistics, and supply chain management.

Analysis and Interpretation of Findings

The interview was analyzed using the triangulation method by bringing the views of key stakeholders relevant to the study. Key informant interviews (KII) were conducted with directors and deputy directors from the Lagos State Ministry of Environment, Lagos Waste Management Authority (LAWMA), and transport operator companies. The interview section covers pre-digitalization and post-digitalization policies in the circular economy, as well as the current contextual factors of the circular economy on supply chain practices in Lagos State, Nigeria.

In addition, five key informant interviewers (KII) were selected from the Lagos State Ministry of Environment, Lagos Waste Management Authority (LAWMA), private sector participation (PSP) in waste collection, and transport operator companies, making it twenty KII. The interview was analyzed using suitable multiple-cases and cross-cases analyses.

Multiple-case Analysis

The Circular Lagos 2021 and Circular Economy Hotspot 2023 initiatives provide a comprehensive roadmap for pioneering the transformation of the present manufacturing order towards regeneration and sustainability. The initiative aims to create a new pattern of production and consumption that includes the manufacture, repair, and recycling of used materials. Based on this, the interview guide generated a set of questions on Lagos' circular economy policies before and after digitization. The Directors and Deputy Directors of the Lagos State Ministry of Environment who were interviewed acknowledged that the state is

yet to have a policy document on circular economy, only a roadmap document. The documentary evidence proposes significant reforms to legal and regulatory frameworks to support circular economy activities, such as new legislation and amendments to existing laws. Furthermore, the document underlines the need for cross-sector collaboration and stakeholder participation in ensuring a successful transition.

In Lagos Waste Management Authority (LAWMA), the directors and deputy directors in the agency opined that the roadmap document would coordinate and facilitate the transition from materialization to dematerialization initiatives, as well as support and monitor project implementation. It emphasizes developing local technologies and innovations in waste management that would offer a systematic approach to addressing global economic crises occasioned by pollution, climate change, and loss of biodiversity. It is a deliberate transition towards inclusive and sustainable economic growth by encouraging sustainable consumption and production patterns. These are indices that assess Lagos' compliance with Sustainable Development Goals (SDGs) 8, 9, and 12 on the promotion of inclusive growth and building a resilient infrastructure.

The key informants interviewed from the private sector participation (PSP) in waste collection believe that the current Roadmap document lacks simplicity and expectations for immediate, clear results or outcomes, which are critical for keeping stakeholders motivated and engaged, as well as securing ongoing political support given the short-term nature of political officeholders in a democracy. While the long-term goals are clearly defined, they lack emphasis on short-term achievements that are necessary to build momentum and affirm the strategy's effectiveness to all parties involved. In addition, the year gap between the short and medium terms seems overlapping and unrealistic. The roadmap recognizes the private sector's critical role in building a circular economy, but it does not emphasize the need for strong incentives to boost corporate involvement. Tax breaks, subsidies, or other financial incentives could be key in motivating companies to invest in circular technologies and practices. To foster a culture of circular behaviors, effective communication strategies that engage and resonate with everyone, from policymakers to the general public, are required.

As for the transport operator companies, the key informant's interviews revealed that the implementation framework is robust but lacks specific mechanisms for accountability and effective progress measurement in the sectors identified. For example, the roadmap mentions recycling in the organic and solid waste from households, marketplaces, and food processing industries but lacks clear, actionable strategies or specific policy measures to promote opportunities for large-scale composting or anaerobic digestion to generate fertilizer and biogas, necessitating more detailed planning and clear, measurable indicators of success for better transparency and public trust.

Meanwhile, there is an emphasis on capacity development in logistics and supply chain management, which are vital for the success of circular economy initiatives in the state. Integrating circular economy principles into existing laws and institutional practices requires strong political will, akin to other major state initiatives. For example, the extensive use of

technology like RFID, barcoding, and IoT sensors in waste reduction, material substitution, and process optimization by manufacturing, warehousing, and transportation sectors significantly improved supply chain capacity to track the movement and status of materials, components, and finished goods. The effectiveness of the roadmap is partly determined by the state's overall economic climate, including the ease of doing business and stable regulatory environments in the state.

However, the present contextual factors in the state, as revealed by the government ministries' emphasis on the success of the Circular Economy Roadmap, could be strongly related to the state's general economic stability and business environment. They highlighted crucial factors like the ease of doing business, infrastructure availability, private sector operators, and the potential for international partnerships. For instance, the roadmap could utilize the abundant waste resources in Lagos and explore partnerships with countries like Ghana and other West African countries in the region, where businesses are skilled at transforming waste. While the roadmap includes a framework for monitoring and evaluation, stakeholders would benefit from a more dynamic approach that regularly reviews progress and adapts strategies based on real-time data and feedback.

According to the private sector participant (PSP) key informants interviewed in waste collection, they were of the view that establishing independent governance structures is critical to the circular economy in the state. Furthermore, establishing a Circular Economy Business Environment Office could significantly streamline circular economy activities, improve ease of doing business, and foster partnerships among critical stakeholders. This agency may also act as a central coordination point for initiatives between the state and local governments, promoting more unified and effective development throughout the state. These governance structures should be insulated from political changes and equipped with the authority and resources to oversee the roadmap's implementation, including representatives from the government, private sector, academia, and civil society to ensure a balanced and inclusive approach. As a result, key informants questioned from the private sector participation (PSP) emphasized the need to widen education and training programs by incorporating circular economy principles more extensively into educational curriculum at all levels, from primary to tertiary education. This approach intends to go beyond only producing a competent workforce that can support the transition to a circular economy but also developing a circular economy culture over time.

Consequently, the interview with key informants of the transport operator companies revealed that the digital marketplace for secondary materials and byproducts facilitates circular economy activities by incorporating AI-powered analytics into the digital waste management platform, allowing for the optimization of waste collection, transportation, and recycling logistics. The recent ban on Styrofoam in Lagos serves as a contemporary contextual factor in waste management policy solutions in the circular economy of the state. They contended that digitization is an enabler for smart waste collection systems, as businesses are now deploying smart waste collection systems that use sensors, real-time data analytics, and IoT to optimize waste collection schedules and routes, lowering fuel

consumption while also enabling more effective recycling. This system generates data on waste composition, location, and volume, enabling more effective resource management.

Cross-cases Analysis

Based on the interviews, private sector participants (PSPs) and transport operator businesses confirmed that incorporating technology into their everyday routines improves circular economy operations in Lagos State. They agreed that a multifaceted approach is required to address the challenges of limited access to information, implying the need to invest in communication infrastructure, technology, and capacity building, as digitization has set the pace for a new economic model that would set new trends and standards in sustainability. According to the interview, the government's goal is to create an enabling environment for the circular economy to thrive. The state is on the verge of reinventing the manufacturing process into a circular one, encouraging sustainable waste collection, upcycling, and recycling.

According to government agencies, developing long-lasting and high-quality flip-flops would reduce waste generation, allowing the state to create a new cycle of material usage and protect future generations from scarcity. In terms of sachet water waste, they advocated for the creation of a circular economy hub to solve gaps in collection, processing, and treatment. They stated that they needed to build a market for off-takers, improve the value, provide a drop-off location, and minimize the carbon emissions associated with recycling the plastic sachet water. One may argue that the government is more concerned with policy and job creation than the operations of the circular economy in the state. This demonstrates the divergent viewpoint between the government's weak enforcement policies and the operators that operate in the circular economy climate for profitability. The operators recognize the potential of the circular economy, as the state is currently experiencing massive inflows of business operators in the circular space who use technology as an enabler to improve waste segregation, recycling efficiency, and innovative recycling processes. It is also pertinent to highlight the significance of infrastructures, as they pose significant challenges for businesses in terms of transportation and product distribution costs in supply chain management in the state.

Discussion of the Findings

This study produced descriptive and inferential results from the collected data. Descriptively, circular economy control variables that were collected from all participants included smart waste collection, recycling optimization, waste segregation, and innovative recycling processes. Participants reacted to the numerous items, and their responses were showcased accordingly. Data integration, digital divide, and digital tools for circular supply chains were the three digitalization policy survey items for which data was collected from all participants. The participants responded to numerous items, stating that the adoption of new technologies for business and environmental sustainability might result in significant expenses. Going digital is not inexpensive, so it may not immediately result in high business performance. Also, the state suffers from inadequate infrastructural issues, such as unreliable internet services and irregular electricity power supply, which pose significant challenges for businesses in the state. Similarly, poor road conditions and insecurity artificially increase the cost of transportation and distribution of products in supply chain management.

This study found that the circular economy in the state would benefit maximally from the digitalization exercise provided the government solved the identified challenges as it would open new platforms and processes that promote business services, create employment, and improve environmental sustainability. It is worth noting that competition, the desire for growth and efficiency, and customer satisfaction all drive business owners to use digital technology in logistics and supply chain management. According to the interview results, most business operators are unfamiliar with the idea of a circular economy. Those who are familiar with the circular economy see it as a business perspective and an ecological necessity. Some business owners have created recycling systems and collaborated with other organizations to pursue various circular economy initiatives that are both economically and ecologically sustainable. The above findings are consistent with the perspectives of Oyelola et al. (2017), Ogundele et al. (2018), and Nwosu & Chukwueloka (2020) on effective solid waste management in the circular economy in Lagos State, Nigeria. The findings indicate that digitalization is positively correlated with the circular economy. This has accelerated the move towards technological adoption as many businesses are compelled to adopt the internet and data analytics to optimize resource usage, improve efficiency, reduce waste, and extend the product lifecycle.

Conclusions and Study Implication

The study concludes that circular economy practices unlock new opportunities for businesses in Lagos. Repair and manufacturing firms can develop, creating jobs and economic growth. The study underscores the essence of investing in robust digital infrastructure, such as high-speed internet connectivity, cloud computing resources, and IoT sensor networks, to enable the seamless integration of digital technologies into circular economy initiatives. The study recommended that the government should establish an enabling environment by investing in infrastructure, promoting digital literacy, and encouraging innovation in the circular economy space. However, the state must incentivize digital adoption and invest in skills development that would encourage corporate collaboration, knowledge sharing, and the development of best practices. Therefore, Lagos State's circular economy digitalization policy has significant policy implications for supply chain management practices. Lagos State Government must develop a comprehensive regulatory framework that supports and incentivizes the adoption of circular economy and digital technology. This might include amending existing waste management regulations, creating tax breaks for circular businesses, and developing standards for data sharing and platform interoperability.

Furthermore, the policy's emphasis on digital waste management platforms suggests the need for the government to examine existing waste management regulations to align with the circular economy principles and enable the seamless integration of digital technology. In addition, the policy's implication on public-private partnerships and stakeholder engagement implies that the government should facilitate and incentivize collaborative supply chain initiatives, such as joint research, pilot projects, collaborative financing mechanisms, and knowledge-sharing platforms, to drive the adoption of digitally-enabled circular supply chain practices. Also, the policy's implication on digital skills development suggests that the government should collaborate with educational institutions, industry associations, and

training providers to develop comprehensive capacity-building programs programs equip supply chain actors, especially SMEs and informal sector participants, with the necessary digital and circular economy competencies.

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