KASBIT BUSINESS JOURNAL

Journal homepage: www.kbj.kasbit.edu.pk

UNVEILING THE LINK BETWEEN DIGITILIZATION AND PERFORMANCE OF THE CIRCULAR ECONOMY: INSIGHTS FROM THE FOOD SECTOR IN BRADFORD

Hina Mushtaq[i], Muhammad Adeel Butt[ii] & Saima Kanwal[iii]

i) Government Islamia Graduate College, Sargodha Road, Faisalabad, Pakistan.
ii) Research Scholar, Bradford University School of Management, United Kingdom.
iii) Research Scholar, University of Sargodha, Women Campus, Faisalabad.

ARTICLE INFO

Keywords:
Digitalization, Circular economies, Digital Business Innovations.

ABSTRACT

Digitalization holds significant potential for optimizing the performance of global economic systems by maximizing the efficient utilization of resources within production frameworks. Despite this potential, there has been a notable lack of exploration into the specific effect of digitalization in increasing the performance of the circular economies within specific context of industries. This study is an attempt to fulfil this gap by quantitatively studying how digitalization affects the performance of circular economy model in the food sector of UK. By collecting the data from employees, investors and entrepreneurs, the study has used regression analysis to rigorously test the link among digitalization practices and performance indicators of circular economy that includes material recycling, resources conversation and extension of product lifespan.

Results from the regression analysis indicate a significant and positive impact of both digital practices for sustainability and digital business innovations on circular economy business models. Furthermore, the study underscores the role of circular economy models in resource conservation through material recycling and product lifespan extension. It highlights the overarching objective of circular economies to maximize the economic value derived from production systems globally. Innovative business practices facilitated by digitalization are being leveraged to optimize resource utilization effectively.

Existing literature corroborates the notion that the adoption of innovative business practices contributes to enhanced performance within circular economies. Digitalization emerges as a key driver for the development of models of circular economy, particularly within the Bradford region. These findings underscore the transformative potential of digitalization in shaping the future of circular economy frameworks, ultimately driving sustainability and efficiency within economic systems.

Corresponding Authors: Dr. Hina Mushtaq
Email: hina.mushtaq.uos@gmail.com

Received: 11th July, 2024
Received in revised form: 30th April, 2025
Accepted: 2nd May, 2025

1. Introduction

The world's population is putting much pressure on its resources than its capacity and polluting the environment (Larsson and Lindfred, 2019). The world has broken the record of the ingestion of its natural and economic possessions. It is using around 100 billion tons of resources as per the latest statistics (Rizos et al., 2021). The fertility rates are expected to grow further in future. As per the latest statistics of UN, the world population will increase to 9.8 billion by the end of 2050. They further claim that if the people of this world keep using the plastics with the same pace, then the world's oceans will get filed by the plastics and their number will exceed the number of fishes (Medd, R.J., 2020; Rhodes, C.J., 2019). The world economic system is using the model for their consumption that believes in "take, make, and throw away" (Baker-Brown, D., 2024; Laranja, M. and Pinto, H., 2022). However, a shift can be seen in the last decade because economies are now moving towards the circular models and this idea is grabbing the attention of the individuals. The model of circular economy is the only solution that can remedy the current alarming situation and challenges that are directly linked with the existing business models (Berg and Wilts, 2019).

The pandemic of Corona Virus has brought calamities in the whole world that resulted in the lost jobs of individuals and majority of the companies get bankrupt (Abodunrin, O., Oloye, G. and Adesola, B., 2020; Skvortsova, T.A., et al., 2020). The extensive literature has shown that the model of circular economy is the only solution that is left behind for the survival of world's economic system after the destruction of novel Corona virus. The businesses have to use the model of circular economy and left the usage of traditional business model (Liu et al., 2021; Lüdeke-Freund, F., Gold, S. and Bocken, N.M., 2019). The new proposed model has the ability to create the value for the world economic system. However, the shift to this model is a long and tedious process besides its huge demand in the market. It requires the amendments in the prevailing business practices, regulations, strategies, and approaches. This study aims at finding the current business practices and digital innovations that are existing in the circular economic model in Bradford.

The globe is in the fourth era of industrial revolution that is making use of the latest technologies that includes 3D technologies, Artificial Intelligence, Machine Learning, Cloud Computing, Blockchains, and Information Technology. All of these technologies are benefiting the different sectors of our economies by solving their issues and by benefiting the individuals (Arthur et al., 2022). The Circular Model of economy is an amendment to the prevailing models and it's not an extension. It makes use of all the innovations and digital technologies that helps to ground the base of

circular economy model (Agarwal et al., 2022). These tools are devised for the help of businesses because these enable the corporations to manage their resources much efficiently, and shut their managerial loop. Its main elements are sharing, renting, and leasing and it's not based on the conventional items of purchasing and then selling the items and it put its base for the model of circular economy.

Recent studies have shown that the digitalization is making use of new technologies of IoT, AI, Big data, and ML and playing a transformative role in the development of circular economy models especially in the food sector (Xu, A., et al., 2023.; Papadopoulos, T., et al., 2022). These advancements are increasing the efficiency, innovative practices, and monitoring of the operations. Despite this progress, there still remain the gap because majority of the studies have focused on conceptual models at macro level only and limited work is done on regional or firm level. This study is addressing this gap because transition to a circular economy is not only important due to consumption of resources but it is complex as well. It requires actionable support from the policymakers and practitioners as well. Consequently, this study is built on innovation theory to empirically examine how digitalization is supporting the circular economy model in the food sector of the UK.

1.1. Study's Scope and Rationale:

Digitalization facilitates the adoption of the circular economic business model (Lawrenz et al., 2021). The Circular Economy model has the unique feature because it makes the use of the entrepreneurs, who bring new ideas into the business. It also facilitates the process of digitalization as well because it introduced the elements of sustainability in it. Digital technology plays a significant role in the development of this model. However, the area of consumer electronics and usage of digital technologies is still unexplored. The amalgamation of digital technologies in the circular economy system has yet to receive comprehensive attention in academic research. Consequently, the current study has the objective to examine the part of digitalization in enhancing the circular economy. While current scholars have primarily concentrated on the manufacturing and finance sectors, other industries have been neglected. There is a pressing need of studying these sectors and the role of circular economy model (Bressanelli et al., 2018). More research is required to understand the impact of digitalization on advancing the circular economy. This study seeks to address this gap by investigating how digitalization contributes in enhancing the performance of food sector in Bradford that are making use of circular economy model.

2. Literature Review

The known scholars in the field of digitalization and circular economy are numerous (Bressanelli et al., 2022b). Bressanelli et al. (2022b) have introduced IoT in the services sector. This framework encompasses the change in the process of value creation that help in increasing the performance (Antikhinen et al., 2018). The usage of latest digital technologies have revolutionized the product utilization, operational layout, and refurbishment. Noman et al. (2022) have investigated an interactive model that establishes links among six prominent business model approaches, including the Resilient Structure, which is aligned with the capabilities of big data associated with each strategy. Additionally, Roseen (2019) has emphasized the imperative of integrating blockchain applications into the value-centric approach of companies. Through this transformation of models with digital technologies, organizations can get the help of latest Artificial intelligence and machine Learning (Vinsjic et al., 2018).

Kalogiannidis S. et al. (2022) have found the positive link between circular economy model and digital business innovations. Piscicelli, L., 2023 has done the literature review by reviewing the work of other scholars and found that second order factors of environment are important in circular economy. Digital business innovations and circular economy model are related to each other (Ajwani-Ramchandani et al., 2021). It makes the use of latest technologies (Ingemarsdotter et al., 2019). Literature has shown that the adoption of circular economy model calls for the adoption of digitalization because it helps in increasing the performance of companies (C. Chauhan et al., 2019). Dhir, A. (2022) has explored that IoT and AI are laying an important role in moving the existing economy models to the circular economy models.

The literature also illustrates how companies, particularly those in the United Kingdom, have seized the opportunities presented by digitalization to introduce new business models (Story et al., 2017). The foremost challenge for these companies lies in identifying and selecting digital advancements within their environment. These new digitalized business models necessitate ongoing operational enhancements to maintain competitiveness in the marketplace. It is imperative for companies to collaborate closely with their stakeholders (Story et al., 2017) because it is important for them. Adopting sustainable practices in the workplace becomes achievable when companies satisfy all of their stakeholders.

2.1. Literature on Circular Economy

The literature on the digitalization and circular economy have the contribution of many known scholars (Mulvey, 1976; Building, 1966). Pearce and Turner (1990) have introduced the model of circular economy in the Europe. This strategy aimed to evolution to a circular economy era by introducing new rules for waste management and promoting a circular economy mindset (Ranta et al., 2021).

Initially, there was a misconception that circular economies solely aimed at environmental protection (Ranta et al., 2021). However, it became evident that the circular economy encompasses various aspects beyond environmental concerns. The European Commission introduced a new framework in 2018 and provided guidelines for addressing all facets of the circular economy (Ranta et al., 2021).

Linear economy models may yield short-term benefits but pose long-term risks in terms of operations, business, legal, and market factors (Larsson & Lindfred, 2019). Hence, transitioning to more sustainable business models is advisable. The government forecasts significant economic benefits from the adoption of circular models, with potential profits amounting to $4.5 trillion and job creation (Liu et al., 2021).

Different authors offer diverse definitions of the circular economy, emphasizing resource allocation and waste reduction (Antikainen et al., 2018; Rizos et al., 2021; Khan et al., 2021; Alone et al., 2020; Bohmecke-Schwafert et al., 2022; Murry et al., 2017). The central concept of the circular economy, as proposed by Pearce and Turner (1990), find the positive association among digitalization and circular economy models. Various frameworks, such as the 3R, 4R, 6R, and 9R models, delineate different stages of circular economy strategies (Liu et al., 2022a; Bartekova & Borkey, 2022; Potting et al., 2017). These frameworks prioritize concepts like recover, recycle, redesign, repair, rethink, and reusable.

The circular economy model has emerged as a viable approach for economic development, focusing on value creation from waste (Lieder & Rashid, 2016). Businesspersons play a pivotal role in driving this conversion (Bag et al., 2020; Neumeyer et al., 2020; Khan et al., 2021). Even in the

agricultural sector, digitalization is facilitating the integrated monitoring of production processes (Chehri et al., 2020; Kontogeorgos et al., 2017).

Digitalization has a role in helping the companies in meeting their targets of circular economy by gathering, storing, and analyzing the data (Mulhall et al., 2022). Overall, the literature on the circular economy encompasses various parameters and frameworks aimed at advancing sustainability and resource efficiency.

2.2. Digitalization

The advent of Digitalization has significantly transformed people's lives, reshaping social and environmental dynamics over the past three centuries. Originating in the 1760s, the first industrial revolution marked a pivotal shift towards mechanized production, with subsequent revolutions further refining production processes (Allen & Sarkis, 2021). The ongoing fourth industrial revolution leverages emerging technologies to drive Industry 4.0, facilitating production processes and enabling innovations (Noman et al., 2022). At the core of this revolution lies Digitalization, encompassing blockchains, and Machine Learning (Ramesohl et al., 2022).

Digital innovations, particularly those based on the Internet of Things (IoT), form the backbone of the fourth industrial revolution (Bressanelli et al., 2018). However, these advancements are not without disruption, impacting economies worldwide. The widespread adoption of digital tools, such as personal computers since the 1980s, has revolutionized industries, making automation more accessible and cost-effective (Khan et al., 2021). The internet serves as a central hub for digital technologies, fostering digital economies built on knowledge, tools, and information (Pagoropoulos et al., 2017).
The COVID-19 pandemic further underscored the importance of Digitalization, prompting the adoption of telemedicine, online education, and remote work models (Liu et al., 2022). Digital technologies have been instrumental in enabling businesses to adapt and survive during these challenging times.

Principles of Digitalization have revolutionized information management, enhanced transparency and streamlining companies' operations (Yang et al., 2018). These principles also underpin the transition to circular economy models, facilitating the redesign of business processes,

products, and services (Cagno et al., 2021). Automation and optimization processes, driven by digital technologies, enhance productivity and reduce costs (Parida et al., 2019).

Businesses leveraging digital tools have witnessed significant performance improvements (Antikainen et al., 2018). Digitalization is instrumental in transitioning to circular economy models, translating theoretical principles into actionable strategies (Garcia-Muina et al., 2018a). Moreover, digital technologies empower organizations to make informed decisions, optimize processes, and improve product sustainability (Mboli et al., 2020). Machine learning algorithms further optimize organizational processes, while AI-based image recognition aids in waste management (Bressanelli et al., 2018a; Wilts et al., 2021).

Digital platforms, coupled with IoT solutions, facilitate the transition to service-based models, enhancing consumer choice and convenience (Hedberg & Sipka, 2021). Companies prioritize maintaining robust relationships with stakeholders, crucial for transitioning to circular economy models (Hedberg et al., 2020). While existing literature has primarily focused on finance and industrial sectors, there remains a gap in understanding Digitalization's holistic role in fostering circular economies (Bressanelli et al., 2018; Rizos and Bryhn, 2022). Addressing this gap is vital for comprehensively exploring Digitalization's impact on circular economy performance. Thus, the study aims to investigate Digitalization's effect on enhancing the circular economy performance in Bradford, presenting the following hypotheses:

H_1 = There exists a positive connection between digital sustainability practices and the circular economy performance of the food sector.

H_2 = There exists a positive association between digital business innovations and the circular economy performance of the food sector.

3. Research Methodology

3.1. Research Design:

This research employs a quantitative research methodology, utilizing cross-sectional data to conduct its investigation. Quantitative techniques are favored due to their ability to gather objective data, which can be analyzed using numerical and statistical methods facilitated by software tools (Queiros et al., 2017). The questionnaire utilized in this study draws from previous works by Kanungo

(1982), Jenny et al. (2016), and the Digital Business Survey (2019). With government support driving the digitalization of businesses in Bradford, the study focuses on these digitally-enabled enterprises, gathering data from entrepreneurs, investors, and employees through purposive sampling. The aim is to explore the role of digitalization in fostering the development of Bradford's circular economy.

3.2. Technique for Data Analysis

The research has employed a quantitative research methodology, and used the regression analysis for checking the impact of explanatory variables on the performance of circular economy model in the food sector of Bradford. The analysis was conducted using the following regression equation:

$$\mathbf{BMCE} = \beta_0 + \beta_1 \mathbf{DPS} + \beta_2 \mathbf{DBI} + \mathcal{E}$$

The outcome variable is the performance of the circular economy model and it has shown as BMCE. The intercept is represented by β_0, while X_1 and X_2 stands for the explanatory variables of sustainability and digital business innovations respectively. The error term is denoted by Ɛ. Subsequently, hypothesis testing was conducted at a significance level of 5%. Additionally, the high value of Cronbach's Alpha, at .959, indicates the reliability of the measures employed in this study to assess changes in the dependent variable.

4. Data Analysis and Interpretation

4.1 . Descriptive Statistics of Demographics

The results have shown that 120 individuals were involved in this research and those were from the food sector of Bradford in UK. Descriptive statistics further indicate a balanced representation of both genders, with participants ranging from certificate holders to PhD holders within the educational spectrum. Additionally, the data illustrates a diverse range of professional experience among respondents, with the majority having less than five years of tenure, while others have more than a decade of experience.

Table 1: Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Gender	1.00	3.00	1.6667	.50764
What is the level of your Education?	1.00	5.00	2.6667	.77061
What is your experience in this sector?	1.00	3.00	1.3000	.55911

4.2 . Reliability Test

The results of reliability test have shown below in Table 2. It shows the value of 0.897 and it should be more than 0.70. Therefore, the measuring instruments have high level of reliability in measuring the variables.

Table 2: Reliability Test

Reliability Test	
Cronbach's Alpha	**No. of Items**
0.897	3

4.3 . Demographic Characteristics of Respondents

The results shows that majority of people, comprising 63.3% of the study, identified as female, while males represented 42% of respondents. A small fraction, 1%, opted not to disclose their gender. Regarding educational attainment, the largest proportion of participants (55%) held bachelor's degrees, followed by 40% who possessed master's degrees. Only 4% reported having diplomas or certificates, while Ph.D. holders constituted merely 5% of the sample. Furthermore, the analysis revealed that the majority of respondents (75%) had lower than five years of experience, with 20% boasting 5-10 years of experience, and only 5% possessing over a decade of industry experience.

Table 3: Demographic Characteristics of respondents

Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	42	35	35	35
Female	76	63.3	63.3	98.3
Prefer not to say	2	1.7	1.7	100
Total	120	100	100	

What is your level of Education?

	Frequency	Percent	Valid Percent	Cumulative Percent
Ph.D.	6	5	5	5
Masters	40	33.3	33.3	38.3
Bachelors	66	55	55	93.3
Diploma	4	3.3	3.3	96.7
Certificate	4	3.3	3.3	100
Total	120	100	100	

How long you have been in this sector?

	Frequency	Percent	Valid Percent	Cumulative Percent
Under 5 years	90	75	75	75
5-10 Years	24	20	20	95
More than 10 Years	6	5	5	100
Total	120	100	100	

4.4 . Descriptive Statistics

Below, we present the findings of the descriptive statistics for both the dependent and independent variables:

4.4.1. Digital Practices for Sustainability

The results of descriptive statistics for the digital practices for sustainability has shown in table 4. According to the results, 40% of respondents indicated that they consider the work they typically undertake to enhance their organization's sustainability as the most significant aspect of their professional lives. Furthermore, 33.3% of participants strongly agreed that they personally dedicate themselves to improving sustainability practices within their organizations, considering it an integral part of their daily lives. Additionally, 46.7% of respondents expressed a strong connection between their involvement in digital sustainability practices and their commitment to sustainability efforts, emphasizing the difficulty of severing this connection. Around 43.3% of participants indicated that the majority of their objectives are oriented toward sustainability and involve the use of digital practices, which they consider essential for their organization's sustainability. Lastly, 51.7% of respondents strongly agreed that they often immerse themselves in discussions about digital sustainability practices, with 45% believing that their engagement with such practices is the most significant aspect of their professional endeavors.

Table 4: Digital Practices for Sustainability

Digital Practices for Sustainability	SD	D	U	A	SA
The primary focus of my attention revolves around the efforts I consistently put forth to enhance my organization's sustainability.	8.3	5.0	23.3	23.3	40.0
I am actively engaged in enhancing sustainability practices within my organization.	3.3	13.3	15.2	31.4	33.3
Improving my organization's sustainability is ingrained in every aspect of my life.	1.7	11.7	11.7	41.7	33.3
I am deeply connected to digital sustainability practices in my organization, and severing this connection is challenging.	6.7	8.3	8.3	30.0	46.7

The majority of my objectives are geared towards sustainability and involve the utilization of digital practices.	.7	.3	5.0	3.7	3.3
The integration of digital practices to enhance sustainability within my organization is fundamental to my existence.	.7	.7	6.7	1.7	3.3
I frequently immerse myself in discussions concerning digital sustainability practices.	.7	.0	8.3	3.3	1.7
My involvement with digital practices to enhance my organization's sustainability stands out as the most significant aspect of my professional journey.	.7	.7	3.3	3.3	5.0

4.4.2. Digital Business Innovations:

The results of descriptive statistics of Digital business innovations have shown in table 5. According to the findings, 41.7% of respondents express a strong agreement that Digital business innovations play a crucial role in meeting the expectations of their consumers and increase their business performance by availability and data visibility. Similarly, 43.3% of respondents believe that Digital technologies contribute to enhancing worker productivity through the utilization of improved technologies.

Furthermore, 53.3% of respondents believes that digital business innovations increase the understanding of consumer needs and demands with the help of data collection and its analysis, thereby facilitating digital transformation in business processes. Additionally, 51.7% of respondents indicate that Digital business innovations positively impact employee rendezvous, while progressions in Digital technologies aid in the conversion of waste materials into reusable resources.

Moreover, a significant portion of respondents, 60%, express a strong agreement that digital business innovations increase the circularity in the manufacturing of materials for making them more useable

and recyclable. Then, around 55% and 50% of respondents agrees that these innovations increase the growth due to the data-driven products and enhancements. Then, 48% of people agree that these innovation helps in optimizing the access to the assets of the companies.

Table 5: Digital Business Innovations

Digital Business Innovations	**SD**	**D**	**U**	**A**	**SA**
Innovations in digital business contribute to fulfilling customer expectations.	3.3	5.0	13.3	36.7	41.7
Worker productivity is enhanced by digital technologies such as mobile applications, AI-assisted automation, and improved data access.	6.7	8.3	10.7	31.7	43.3
The management of business performance is facilitated by digital business innovations through enhanced data visibility and availability.	3.3	3.3	11.7	40.0	41.7
Insights into customer needs are amplified by digital business innovations through the collection and analysis of data.	1.7	5.0	6.7	33.3	53.3
Business processes are digitally adapted and modified by digital business innovations.	1.7	5.0	13.3	26.7	53.3
Digital business innovations ensure secure and optimized access to assets.	5.0	1.7	15.0	30.0	48.3
Employee engagement is bolstered by digital business innovations.	3.3	6.7	11.7	26.7	51.7
Novel revenue streams are developed for firms through digital business innovations.	3.3	3.3	5.0	28.3	60.0
Digital business innovations foster high growth by leveraging digital enhancements and data-driven products and services.	1.7	3.3	13.3	31.7	50.0
Digital business innovations facilitate digital globalization by enabling the global	3.3	6.7	13.3	21.7	55.0

movement of goods, services, expertise, and people through the flow of data and information.					
Circularity in product manufacturing is enabled by digital technologies.	3.3	10.0	8.3	33.3	45.0
Digital advancements contribute to making materials more recyclable and reusable.	3.3	13.3	38.3	48.0	45.0
Digital innovations aid in converting waste materials into valuable resources.	1.7	6.7	16.7	23.3	51.7

4.4.3. Business Models of Circular Economy

Table 6 presents the results of the descriptive statistics for the variable of circular economy model. The results demonstrate that majority (37%) of respondents strongly agree that the model of circular economy decrease the requirement of resources due to the recycling of materials. Moreover, their companies are providing training to their employees for fostering the mindset of circular economy model. Moreover, approximately 43% of respondents agree that their companies have set the green objectives for them and offer them with trainings as well. Furthermore, 50% of population indicate that their associations evaluates employees' performance based on their contribution to the circular economy, emphasizing the importance of reusing products to extend their lifetime and increase the economic value of their production systems. Finally, 46.7% of respondents suggest that their companies tie rewards and compensation to employees' circular economy behavior and incorporates circular economy practices into promotion considerations. They underscore the necessity of substantial changes in the value chain system to achieve a high-performing circular economy.

Table 6: Business Model of Circular Economy

Business Models of Circular Economy	**SD**	**D**	**U**	**A**	**SA**
The circular economy facilitates a reduction in resource requirements through material recycling.	15.0	10.0	20.0	23.3	31.7
My organization establishes green objectives for all employees.	3.3	3.3	20.0	30.0	43.3

My organization offers training to employees to promote the circular economy.	1.7	6.7	16.7	31.7	43.3
My company trains the employees for the development of skills of circular economy mindset.	2.9	14.3	20.0	31.4	31.6
My company evaluate the performance of workers based on their contribution to the model of circular economy.	3.3	1.7	18.3	26.7	50.0
My organization ties rewards and compensation to employees' circular economy behavior.	5.0	3.3	11.7	33.3	46.7
My organization takes into account employees' circular economy behavior when considering promotions.	5.0	4.3	11.7	32.3	46.7
Improved circular economy practices involve reusing products, thereby extending their lifespan.	3.3	1.7	18.3	26.7	50.0
The circular economy helps in maximizing and preserving the economic value of production system.	3.3	1.7	18.3	26.7	50.0
Achieving a good performance in the circular system necessitates substantial changes in the value chain system.	1.7	13.3	16.7	21.7	46.7

4.5 Regression Analysis:

The findings from the regression analysis are presented below. In this study, the circular economy serves as the dependent variable, while the variable of digital practices for business innovation and sustainability is taken as the explanatory variables. The regression analysis yielded an R-squared value of .659, indicating that the explanatory variables collectively account for 66% of the variance in the circular economy. However, approximately 34% of the variance remains unexplained by these independent variables.

The F-statistic value is 113.06 and its p value is significant at 5% level. This suggests a valid model fit and shows a linear relationship among the variables under study. Generally, these results provide evidence supporting the connection between Digitalization and the circular economy's enactment within Bradford's food sector.

The constant term is significant at the 5% level, with a value of 8.556. The coefficient value is .280 for digital practices of sustainability, and its associated p-value is .000. This indicates that a 1% change in digital sustainability practices corresponds to a 28% change in the circular economy business model. The variable is thus deemed significant at the 5% level, and confirm the positive effect of digital practices on the dependent variable of circular economy performance.

Similarly, the variable of digital business innovations has the coefficient of .520 that is significant at 5% level. This implies that a 1% change in the digital business innovations would bring around 52% change in the performance of the circular economy model. Hence, this variable is also positively affecting the dependent variable of circular economy performance.

Table 7: Model Summary

MODEL SUMMARY				
MODEL	**R**	**R Square**	**Adjusted R Square**	**Std. The error in the Estimate**
1	.812[a]	.659	.653	4.25958

A. PREDICTORS: (CONSTANT), DPS, DBI

Table 8: Results of ANOVA

Model	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Regression	4102.846	2	2051.423	113.063	.000[b]
Residual	2122.854	117	18.144		
Total	6225.700	119			

a. Dependent Variable: BMCE
b. Predictors: (Constant), DPS, DBI

Table 9: Regression Analysis

Model	Coefficients			t	Sig.
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta		
(Constant)	8.556	2.262		3.782	.000
DBI	.280	.086	.369	3.242	.002
DPS	.520	.126	.468	4.114	.000
a. Dependent Variable: BMCE					

5. Discussions

The confirmation of the initial hypothesis indicates that Digitalization enhances the performance of Bradford's food sector in its circular economy endeavors. This suggests that Digitalization offers businesses valuable opportunities by supplying detailed product data regarding condition, availability, and location, thereby facilitating informed decision-making. The study underscores the significance of having accurate and extensive data for strategic decision-making processes. Furthermore, the findings illustrate how Digitalization enables the virtualization of processes through emerging digital platforms, highlighting its pivotal role in driving sustainability practices within the circular economy framework. By fostering co-creation, collaboration, and networking with stakeholders, including customers, Digitalization promotes the consumer engagement in the development of products and services, as observed by respondents (Bohmecke-Schwafert et al., 2022).

Additionally, the validation of the second hypothesis demonstrates that digitalized business models for circular economies offer the structural prerequisites for manufacturing corporations to achieve both economic and ecological sustainability (Khan et al., 2021). This contributes to improved corporate performance by leveraging digitalized circular economy models that can readily adapt to dynamic environmental conditions (Bartekova & Borkey, 2022). While the complexities of technological solutions may not be fully resolved by pattern layer knowledge alone, it elucidates the role of these technologies in shaping circular economy business models and facilitating best practices implementation within organizations (Bressanelli et al., 2022b). The study advocates for the adoption of models of circular economy, emphasizing the importance of firms collaborating with stakeholders to

leverage digital structures effectively, adapt to outcomes, and refine business operations accordingly. By embracing the layers of mental models, scholars can gain insights into divergent perspectives that inform reactions and rectify assumptions hindering the transition to digitalized circular economies, thereby enhancing organizational sustainability (Khan et al., 2021; Cesari, 1967).

Furthermore, it underscores the necessity of developing new theories to facilitate the move towards the models of circular economy and make sure that firms have sustainability in the long run (Allen & Sarkis, 2021; Antikainen et al., 2018). While Digitalization serves as a catalyst for transitioning to modern circular economy business models, challenges such as environmental restrictions and research limitations underscore the need for ongoing inquiry and innovation (Rizos & Bryhn, 2022; Bartekova & Borkey, 2022).

5.1 Conclusion

The research findings indicate that Digitalization has a positive impact on Bradford's food sector circular economy. Furthermore, a positive relation is found between the digital business innovations and circular economy system. The study underscores how circular economy business models contribute to resource reduction through material recycling and product lifespan extension via reuse practices.

Furthermore, the study illuminates the foundational principle of circular economies, emphasizing the preservation and maximization of economic value across production systems. It highlights the symbiotic relationship between circular economies and various digitalization practices, offering benefits to individuals, businesses, governments, and the environment alike. Digitalization emerges as a pivotal tool in facilitating the transition from traditional linear business models to circular economy paradigms, prioritizing resource conservation and material recycling.

In this context, the collaborative nature of circular business models is emphasized, stressing the importance of engaging stakeholders such as customers, suppliers, distributors, shareholders, and governmental bodies. Leveraging Digitalization, businesses can reimagine their product and service offerings, fostering enhanced collaboration with consumers and stakeholders through online platforms and virtual technologies. These platforms serve as conduits for co-creation processes, enabling businesses to tailor offerings to meet consumer preferences and demands effectively.

Moreover, literature suggests a growing consumer preference for environmentally sustainable e-business practices, underscoring the importance of early adopters in driving the transition to circular

economy models. Respondents in the study advocate for proactive engagement with consumers to progress and implement the models of circular economy. By embracing Digitalization practices, businesses can navigate this transition effectively, enhancing their long-term performance within circular economy frameworks.

References

Abodunrin, O., Oloye, G. and Adesola, B., 2020. Coronavirus pandemic and its implication on global economy. International journal of arts, languages and business studies, 4(1), pp.13-23.

Agrawal, R., Wankhede, V.A., Kumar, A., Upadhyay, A. and Garza-Reyes, J.A., 2021. Nexus of circular Economy and sustainable business performance in the era of Digitalization. International Journal of Productivity and Performance Management, 71(3), pp.748-774.

Ajwani-Ramchandani, R., Figueira, S., de Oliveira, R.T., Jha, S., Ramchandani, A. and Schuricht, L., 2021. Towards a circular economy for packaging waste by using new technologies: The case of large multinationals in emerging economies. Journal of Cleaner Production, 281, p.125139.

Allen, S.D. and Sarkis, J., 2021. How can the circular economy-digitalization infrastructure support transformation to strong sustainability?. Environmental Research: Infrastructure and Sustainability, 1(3), p.033001.

Aloini, D., Dulmin, R., Mininno, V., Stefanini, A. and Zerbino, P., 2020. Driving the transition to a circular economic model: A systematic review on drivers and critical success factors in the circular economy. Sustainability, 12(24), p.10672.

Antikainen, M., Uusitalo, T. and Kivikytö-Reponen, P., 2018. Digitalisation as an enabler of circular Economy. Procedia Cirp, 73, pp.45-49.

Arthur, L., Hondo, D. and Kohonen, R., 2022. Prospects for Transitioning from a Linear to Circular Economy in Developing Asia.

Bag, S., Yadav, G., Wood, L.C., Dhamija, P. and Joshi, S., 2020. Industry 4.0 and the circular economy: Resource melioration in logistics. Resources Policy, 68, p.101776.

Baker-Brown, D., 2024. The re-use atlas: A designer's guide towards a circular economy. Routledge.

Barteková, E. and Börkey, P., 2022. Digitalization for the transition to a resource-efficient and circular economy.

Berg, H. and Wilts, H., 2019, March. Digital platforms as marketplaces for the circular economy—requirements and challenges. In NachhaltigkeitsManagementForum| Sustainability Management Forum (Vol. 27, No. 1, pp. 1-9). Springer Berlin Heidelberg.

Böhmecke-Schwafert, M., Wehinger, M. and Teigland, R., 2022. Blockchain for the Circular Economy: Theorizing blockchain's role in the transition to a circular economy through an empirical investigation. Business Strategy and the Environment.

Bressanelli, G., Adrodegari, F., Perona, M. and Saccani, N., 2018. Exploring how usage-focused business models enable circular economy through digital technologies—sustainability, 10(3), p.639.

Bressanelli, G., Adrodegari, F., Pigosso, D.C.A. and Parida, V., 2022. Towards the Smart Circular Economy Paradigm: A Definition, Conceptualization, and Research Agenda. Sustainability 2022, 14, 4960.

Cagno, E., Neri, A., Negri, M., Bassani, C.A. and Lampertico, T., 2021. The role of digital technologies in operationalizing the circular economy transition: A systematic literature review—Applied Sciences, 11(8), p.3328.

Cesari, G.S., 1967. Henry Jarrett (ed.), Environmental Quality in a Growing Economy (Book Review). Technology and Culture, 8(4), p.523.

Chauhan, C., Parida, V. and Dhir, A., 2022. Linking circular economy and digitalisation technologies: A systematic literature review of past achievements and future promises. Technological Forecasting and Social Change, 177, p.121508.

Chauhan, C., Sharma, A. and Singh, A., 2021. A SAP-LAP linkages framework for integrating Industry 4.0 and circular economy. Benchmarking: An International Journal, 28(5), pp.1638-1664.

Chehri, A., Chaibi, H., Saadane, R., Hakem, N. and Wahbi, M., 2020. A framework for optimizing the deployment of IoT for the precision agriculture industry. Procedia Computer Science, 176, pp.2414-2422.

Foss, N.J. and Saebi, T., 2017. Fifteen years of research on business model innovation: How far have we come, and where should we go? Journal of management, 43(1), pp.200-227.

Garcia-Muiña, F.E., González-Sánchez, R., Ferrari, A.M. and Settembre-Blundo, D., 2018. The paradigms of Industry 4.0 and circular economy as enabling drivers for the competitiveness of businesses and territories: The case of an Italian ceramic tiles manufacturing company. Social Sciences, 7(12), p.255.

Garcia-Muiña, F.E., González-Sánchez, R., Ferrari, A.M., Volpi, L., Pini, M., Siligardi, C. and Settembre-Blundo, D., 2019. Identifying the equilibrium point between sustainability goals and circular economy practices in an Industry 4.0 manufacturing context using eco-design. Social sciences, 8(8), p.241.

Guyot Phung, C., 2019. Implications of the circular Economy and digital transition on skills and green jobs in the plastics industry. Field Actions Science Reports. The Journal of Field Actions, (Special Issue 19), pp.100-107.

Hedberg, A. and Šipka, S., 2021. Toward a circular economy: The role of Digitalization. One Earth, 4(6), pp.783-785.

Hedberg, A., Šipka, S. and Bjerkem, J., 2020. The circular Economy: Going digital. European Policy Centre.

Ingemarsdotter, E., Jamsin, E., Kortuem, G. and Balkenende, R., 2019. Circular strategies enabled by the internet of things—A framework and analysis of current practice. Sustainability, 11(20), p.5689.

Kalogiannidis, S., Kalfas, D., Chatzitheodoridis, F. and Kontsas, S., 2022. The Impact of Digitalization in Supporting the Performance of Circular Economy: A Case Study of Greece. Journal of Risk and Financial Management, 15(8), p.349.

Khan, S.A.R., Ponce, P., Thomas, G., Yu, Z., Al-Ahmadi, M.S. and Tanveer, M., 2021. Digital technologies, circular economy practices and environmental policies in the era of COVID-19. Sustainability, 13(22), p.12790.

Kintscher, L., Lawrenz, S., Poschmann, H. and Sharma, P., 2020. Recycling 4.0-Digitalization as a Key for the Advanced Circular Economy. J. Commun., 15(9), pp.652-660.

Kontogeorgos, A., Sergaki, P. and Chatzitheodoridis, F., 2017. AN ASSESSMENT OF NEW FARMERS'PERCEPTIONS ABOUT AGRICULTURAL COOPERATIVES. Journal of Developmental Entrepreneurship, 22(01), p.1750003.

Laranja, M. and Pinto, H., 2022. Transformation for a post-pandemic world: Exploring social innovations in six domains. Knowledge, 2(1), pp.167-184.

Larsson, A. and Lindfred, L., 2019. Digitalization, circular economy and the future of labor: How circular Economy and digital transformation can affect labor 1. In The Digital Transformation of Labor (pp. 280-315). Routledge.

Lawrenz, S., Leiding, B., Mathiszig, M.E.A., Rausch, A., Schindler, M. and Sharma, P., 2021. Implementing the Circular Economy by Tracing the Sustainable Impact. International journal of environmental research and public health, 18(21), p.11316.

Lieder, M. and Rashid, A., 2016. Towards circular economy implementation: a comprehensive review in context of manufacturing industry. Journal of cleaner production, 115, pp.36-51.

Liu, J., Quddoos, M.U., Akhtar, M.H., Amin, M.S., Tariq, M. and Lamar, A., 2022. Digital technologies and circular economy in supply chain management: in the era of COVID-19 pandemic. Operations Management Research, pp.1-16.

Liu, Q., Trevisan, A.H., Yang, M. and Mascarenhas, J., 2022. A framework of digital technologies for the circular Economy: Digital functions and mechanisms. Business Strategy and the Environment.

Liu, Z., Liu, J. and Osmani, M., 2021. Integration of digital Economy and circular Economy: current status and future directions. Sustainability, 13(13), p.7217.

Lüdeke-Freund, F., Gold, S. and Bocken, N.M., 2019. A review and typology of circular economy business model patterns. Journal of industrial ecology, 23(1), pp.36-61.

Mboli, J.S., Thakker, D. and Mishra, J.L., 2022. An Internet of Things-enabled decision support system for circular economy business model. Software: Practice and Experience, 52(3), pp.772-787.

Medd, R.J., 2020. Conversations with Planet Ocean: Plastic Pollution and the Common Heritage of Humankind. Cross Cultural Studies Review: A journal for comparative studies of culture, literature, and the arts, 2(3-4), pp.83-142.

Mulhall, D., Ayed, A.C., Schroeder, J., Hansen, K. and Wautelet, T., 2022. The Product Circularity Data Sheet—A Standardized Digital Fingerprint for Circular Economy Data about Products. Energies, 15(9), p.3397.

Murray, A., Skene, K. and Haynes, K., 2017. The circular economy: an interdisciplinary exploration of the concept and application in a global context. Journal of business ethics, 140(3), pp.369-380.

Neligan, A., 2018. Digitalisation as enabler towards a sustainable circular economy in Germany. Intereconomics, 53(2), pp.101-106.

Neumeyer, X., Ashton, W.S. and Dentchev, N., 2020. Addressing resource and waste management challenges imposed by COVID-19: An entrepreneurship perspective. Resources, Conservation and Recycling, 162, p.105058.

Noman, A.A., Akter, U.H., Pranto, T.H. and Bahalul, A.K.M., 2022. Machine Learning and Artificial Intelligence in Circular Economy: A Bibliometric Analysis and Systematic. Annals of Emerging Technologies in Computing (AETiC), 6(2).

Pagoropoulos, A., Pigosso, D.C. and McAloone, T.C., 2017. The emergent role of digital technologies in the Circular Economy: A review. Procedia CIRP, 64, pp.19-24.

Papadopoulos, T., Singh, S.P., Spanaki, K., Gunasekaran, A. and Dubey, R., 2022. Towards the next generation of manufacturing: implications of big data and digitalization in the context of industry 4.0. Production Planning & Control, 33(2-3), pp.101-104.

Parida, V., Sjödin, D. and Reim, W., 2019. Reviewing literature on Digitalization, business model innovation, and sustainable industry: Past achievements and future promises. Sustainability, 11(2), p.391.

Pearce, D.W. and Turner, R.K., 1989. Economics of natural resources and the environment. Johns Hopkins University Press.

Piscicelli, L., 2023. The sustainability impact of a digital circular economy. Current Opinion in Environmental Sustainability, 61, p.101251.

Potting, J., Hekkert, M.P., Worrell, E. and Hanemaaijer, A., 2017. Circular economy: measuring innovation in the product chain. Planbureau voor de Leefomgeving, (2544).

Queirós, A., Faria, D. and Almeida, F., 2017. Strengths and limitations of qualitative and quantitative research methods. European journal of education studies.

Ramesohl, S., Berg, H. and Wirtz, J., 2022. The circular economy and digitalisation-strategies for a digital-ecological industry transformation: a study commmissioned by Huawei Technologies Germany GmbH.

Ranta, V., Aarikka-Stenroos, L. and Väisänen, J.M., 2021. Digital technologies catalyzing business model innovation for circular Economy—Multiple case study. Resources, Conservation and Recycling, 164, p.105155.

Rhodes, C.J., 2019. Solving the plastic problem: From cradle to grave, to reincarnation. Science progress, 102(3), pp.218-248.

Rizos, V. and Bryhn, J., 2022. Implementation of circular Economy approaches in the electrical and electronic equipment (EEE) sector: Barriers, enablers and policy insights. Journal of Cleaner Production, 338, p.130617.

Rizos, V., Bryhn, J., Alessi, M., Righetti, E., Fujiwara, N. and Stroia, C., implementing circular economy business models.

Skvortsova, T.A., Pasikova, T.A., Vereshchagina, L.N., Pozdnishov, A.N. and Sukhovenko, A.V., 2020. The problem of bankruptcy of business entities as a consequence of the COVID-19 pandemic.

Story, V.M., Raddats, C., Burton, J., Zolkiewski, J. and Baines, T., 2017. Capabilities for advanced services: A multi-actor perspective. Industrial Marketing Management, 60, pp.54-68.

Wilts, H., Garcia, B.R., Garlito, R.G., Gómez, L.S. and Prieto, E.G., 2021. Artificial intelligence in the sorting of municipal waste as an enabler of the circular economy. Resources, 10(4), p.28.

Xu, A., Darbandi, M., Javaheri, D., Navimipour, N.J., Yalcin, S. and Salameh, A.A., 2023. The management of IoT-based organizational and industrial digitalization using machine learning methods. Sustainability, 15(7), p.5932.