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CLOSED LOOP SUPPLY CHAIN: IMPLEMENTING CIRCULAR ECONOMY PRINCIPLES IN THE FASHION INDUSTRY

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Abstract
This study examined the effect of closed loop supply chain on circular economy implementation in the fashion industry. Closed loop supply chain was measured using reuse and recycling, while circular economy implementation was assessed as a single composite variable. A descriptive survey research design was adopted for the study. The population comprised supply chain managers, sustainability officers and marketing managers of selected fashion firms, from which 214 respondents were drawn. Primary data were collected through a structured questionnaire, while the formulated hypotheses were tested using multiple regression analysis with the aid of Statistical Package for the Social Sciences (SPSS) version 27 at a 0.05 level of significance. The findings revealed that reuse had a significant positive effect on circular economy implementation ($\beta = 0.413$, $p < 0.05$). Similarly, recycling was found to have a significant positive effect on circular economy implementation ($\beta = 0.371$, $p < 0.05$). The model explained 54.3% of the variation in circular economy implementation (Adjusted $R^2 = 0.543$). Based on these findings, all the null hypotheses were rejected. The study concluded that effective closed loop supply chain practices significantly enhance circular economy implementation, with reuse and recycling jointly contributing to a more circular fashion industry. The study therefore recommended that management of fashion firms should strengthen product reuse, take-back and recycling systems as part of their supply chain practices, in order to reduce textile waste, retain product and material value and support a more circular fashion system.

Keywords: closed loop supply chain, circular economy, reuse, recycling, fashion industry, sustainability.

Introduction

Fashion firms (clothing manufacturers, textile producers, garment retailers, fast fashion brands, luxury apparel houses, etc.) design, produce, distribute and sell clothing, footwear and accessories through supply chains that span raw material extraction, textile production,

garment assembly, retail distribution and end-of-life disposal (Ellen MacArthur Foundation, 2017; Niinimäki et al., 2020). The global fashion industry is one of the largest industrial sectors in the world, generating annual revenues in excess of two trillion US dollars and employing over 300 million people across the supply chain. However, fast product cycles, seasonal collections, synthetic fibres and high disposal rates also make it one of the most environmentally damaging industries, responsible for approximately 10% of global carbon emissions, 20% of global industrial wastewater and 92 million tonnes of textile waste annually (Greenpeace, 2016; UNEP, 2019). It was observed that the linear take-make-dispose model that has dominated fashion supply chains for decades does not fit with long-term environmental sustainability, and as such closed loop supply chain (CLSC) practices, through which materials and products are recovered, reused and recycled back into the production system, have emerged as one of the most significant responses to this challenge (Guide & Van Wassenhove, 2009; Govindan & Soleimani, 2017). How well fashion firms implement circular economy principles is increasingly seen as both an environmental imperative and a commercial differentiator, in markets where sustainability credentials carry more and more competitive weight (Bocken et al., 2016).

Circular economy implementation refers to the degree to which an organisation embeds circular economy principles (closing material loops, extending product lifespans, eliminating waste, regenerating natural systems, etc.) into its operations, supply chain and business model (Ellen MacArthur Foundation, 2013; Geissdoerfer et al., 2017). The circular economy itself is broadly understood as an economic system that replaces the traditional linear model of production and consumption with one in which resources are kept in use for as long as possible, maximum value is extracted from them while in use, and materials are recovered and regenerated at the end of each service life (Murray, Skene, & Haynes, 2017). Scholars have argued that implementation is multi-dimensional. It covers product design for longevity and disassembly, closed loop material flows, reverse logistics infrastructure, business model innovation and the cultivation of extended producer responsibility (Kirchherr, Reike, & Hekkert, 2017; Zhu, Geng, & Lai, 2010). In the fashion industry it is particularly challenging because of the complexity of global fashion supply chains, the prevalence of blended fibres that resist recycling, fast product turnover and the cultural normalisation of disposable fashion consumption (Niinimäki et al., 2020; Moorhouse & Moorhouse, 2017).

Closed loop supply chain (CLSC) refers to the integration of forward and reverse supply chain flows into one system in which products, components and materials are recovered after use and reintroduced into the production cycle (Guide & Van Wassenhove, 2009; Fleischmann et al., 2001). What defines a CLSC is that it closes the material loop: materials flow from producers to consumers, and they also return from consumers to producers through take-back schemes, collection systems, refurbishment processes and recovery facilities (Govindan & Soleimani, 2017). Scholars have identified reuse and recycling as two of the most operationally foundational dimensions of closed loop supply chains. Reuse is the recovery and re-deployment of products or components in their existing form or with minimal processing, which extends the productive lifespan of materials without the energy and resource inputs needed for remanufacturing (Thierry et al., 1995; Lund, 1984). Recycling, on the other hand, is the recovery and reprocessing of post-consumer or post-

industrial materials into new raw materials or products, which lets resources re-enter the production system even when the original product cannot be reused directly (McDonough & Braungart, 2002; Stahel, 2016). Together, reuse and recycling make up the practical operational architecture through which fashion firms close material loops and turn circular economy principles into measurable supply chain practice.

Prior empirical studies have looked at closed loop supply chain practices and circular economy outcomes in various industrial contexts. Govindan and Soleimani (2017) reviewed the closed loop supply chain literature and found that reuse and recycling are consistently the most operationally significant drivers of circular economy performance, with firms that operationalise both dimensions at the same time recording significantly higher sustainability outcomes than those pursuing either one alone. Bocken et al. (2016) examined circular economy implementation in the fashion and retail sectors and found that firms which integrate take-back programmes, garment reuse schemes and fibre recycling infrastructure into their supply chains achieve higher levels of circular economy adoption, less material waste and better environmental performance. In the apparel industry, De Angelis et al. (2018) reported that recycling attracted considerable managerial attention, but reuse strategies were associated with stronger long-term implementation outcomes because they preserved more embedded value and needed less energy-intensive processing. Moorhouse and Moorhouse (2017) similarly found that fashion firms that committed to closed loop practices as an integrated strategy, and not as peripheral add-ons to conventional linear supply chains, were much more effective in achieving circular economy implementation and in communicating their sustainability credentials to consumers. What is evident from these studies is that reuse and recycling are both meaningful, independently significant drivers of circular economy implementation in the fashion industry. Yet, to the best of the researcher's knowledge, their combined quantitative effect on composite circular economy implementation in the fashion industry has received little empirical attention. It is against this background that this study seeks to examine the effect of closed loop supply chain (operationalised through reuse and recycling) on circular economy implementation in the fashion industry.

2. Literature Review

Circular Economy Implementation

Circular economy implementation is one of the most significant operational and strategic challenges facing industrial firms in the twenty-first century, and as such it has attracted fast-growing scholarly and policy attention over the past two decades (Ellen MacArthur Foundation, 2013; Geissdoerfer et al., 2017). It refers to the degree to which an organisation actively and systematically embeds circular economy principles into its operations, supply chain design, product development processes and business model, replacing the linear take-make-dispose paradigm with a regenerative, closed loop system of resource use (Murray et al., 2017; Kirchherr et al., 2017). The circular economy itself rests on the idea that industrial systems should copy the cyclical flows found in natural ecosystems, where there is no concept of waste because every output from one process becomes a resource input for another (Ellen MacArthur Foundation, 2013; Stahel, 2016).

Several theoretical frameworks have been advanced to explain the origins, logic and implementation pathways of the circular economy. Industrial ecology theory, introduced by Frosch and Gallopoulos (1989), holds that industrial systems can and should be redesigned to work like biological ecosystems, with cyclical material and energy flows and waste from one process feeding another. The Natural Resource-Based View, developed by Hart (1995), extends the Resource-Based View by arguing that firms which build capabilities in pollution prevention, product stewardship and sustainable technology achieve unique competitive advantages that firms operating within purely linear supply chain models cannot replicate. Cradle to Cradle design theory, articulated by McDonough and Braungart (2002), gives the design-level logic for implementation: products and materials should be designed from the outset to be either fully recyclable technical nutrients or fully biodegradable biological nutrients, so that waste is eliminated at the design stage.

In the fashion industry, circular economy implementation covers a wide range of practices, which include designing for disassembly and fibre recovery, garment take-back and rental schemes, closed loop dyeing and finishing systems, sourcing of recycled fibres, and reverse logistics infrastructure capable of recovering post-consumer garments at scale, etc. (Niinimäki et al., 2020; Bocken et al., 2016). Scholars have argued that it is not just a regulatory compliance exercise but a fundamental strategic reorientation that touches every link in the fashion supply chain, from raw material sourcing to end-of-life recovery (Moorhouse & Moorhouse, 2017; De Angelis et al., 2018). It was observed that firms which build circular economy principles deeply into their supply chain architecture, and do not treat circularity as a peripheral corporate social responsibility activity, achieve the most substantial and durable sustainability performance gains.

Closed Loop Supply Chain

Closed loop supply chain (CLSC) is the operational architecture through which firms give practical effect to circular economy principles within their supply chain systems. It integrates forward supply chain flows (from raw material extraction through production and distribution to the end customer) and reverse supply chain flows (from the end customer back through collection, sorting, reprocessing and remanufacturing to re-entry into the production system) into one operational framework (Guide & Van Wassenhove, 2009; Fleischmann et al., 2001). What separates it from a conventional linear supply chain is the closure of the material loop. Instead of materials and products flowing one way from production to disposal, they are recovered and reintroduced into the value creation cycle (Govindan & Soleimani, 2017).

In the fashion industry, closed loop supply chain systems cover a range of structural and operational mechanisms, which include take-back programmes that collect used garments from consumers, sorting and grading facilities that categorise recovered materials for different recovery pathways, refurbishment and repair services that extend garment lifespans, fibre-to-fibre recycling technologies that break down blended textiles into reusable raw materials, and digital product passports that track the material composition of garments to ease end-of-life processing, etc. (Ellen MacArthur Foundation, 2017; Govindan & Soleimani, 2017). Adoption of these practices has been pushed by regulatory pressures, most notably

the EU Strategy for Sustainable and Circular Textiles (European Commission, 2022) and Extended Producer Responsibility schemes, and by demand from more sustainability-conscious consumers (Niinimäki et al., 2020). In this study, closed loop supply chain is operationalised through its two most foundational operational dimensions: reuse and recycling.

Reuse

Reuse, as a dimension of closed loop supply chain, refers to the recovery and re-deployment of products, garments or components in their existing or near-existing form, without energy-intensive remanufacturing or chemical reprocessing, which extends the productive lifespan of materials and preserves the embedded value of earlier production inputs (Thierry et al., 1995; Lund, 1984). In the fashion industry it covers practices such as second-hand garment markets, rental and leasing platforms, garment repair and alteration services, peer-to-peer clothing exchange schemes and retailer-operated resale programmes, etc. (Ellen MacArthur Foundation, 2017; Moorhouse & Moorhouse, 2017). Reuse is widely regarded in the circular economy literature as the highest-priority recovery strategy, because it preserves more embedded value per unit of material than any other end-of-life pathway, recycling included (Stahel, 2016; McDonough & Braungart, 2002).

It was observed that fashion firms which institutionalise reuse at the supply chain level (through take-back schemes, repair-as-a-service offerings and second-life retail formats) make the most direct and energy-efficient contribution to circular economy implementation, because these strategies bypass the reprocessing stages that recycling requires and keep more of the original product value in the system (De Angelis et al., 2018; Bocken et al., 2016). Zhu, Geng, and Lai (2010) found that firms with strong product recovery and reuse programmes recorded significantly higher circular economy implementation scores than those relying only on recycling, since reuse preserves several layers of embedded value (design, labour, energy and material, etc.) that are lost for good in the recycling process. In the present study, reuse is therefore treated as the primary recovery dimension of closed loop supply chain and as the strongest hypothesised predictor of circular economy implementation.

Recycling

Recycling, as a dimension of closed loop supply chain, refers to the recovery and reprocessing of post-consumer or post-industrial textile materials into new raw materials, fibres or products, which lets resources re-enter the production system even where direct reuse is not feasible because of the condition, contamination or material complexity of the recovered garment (McDonough & Braungart, 2002; Stahel, 2016). In the fashion industry it includes mechanical recycling, in which garments are shredded and reprocessed into lower-grade fibres, and chemical recycling, in which garments are chemically depolymerised and reconstituted into virgin-quality fibres. It also includes repurposing recovered fabrics into non-apparel products such as insulation, cleaning cloths and composite materials, etc. (Niinimäki et al., 2020; Moorhouse & Moorhouse, 2017).

Recycling sits lower than reuse in the circular economy value hierarchy because it needs more energy input and gives a lower-value output. Even so, it is an essential dimension of closed loop supply chain for the fashion industry, because the scale, diversity and material complexity of fashion waste mean that a significant share of recovered garments cannot be reused directly (Ellen MacArthur Foundation, 2017). Govindan and Soleimani (2017) found that fashion firms with structured fibre recycling infrastructure recorded significantly higher levels of circular economy implementation than those without, and that combining reuse and recycling in one closed loop system produced the strongest outcomes. In this study, recycling is therefore operationalised as the second dimension of closed loop supply chain and as a significant, complementary predictor of circular economy implementation alongside reuse.

A. Empirical Review

Cocquyt et al. (2020) examined organizational characteristics that explain participation in sustainable business models within the fashion sharing economy. The study focused on the extent to which organizational features influence the attractiveness of clothing sharing platforms as an alternative to conventional clothing ownership. The researchers conducted exploratory focus groups and an online survey involving 1,512 respondents, using conjoint analysis to assess preferences for different organizational characteristics. The attributes examined included the size of sharing platforms, partnerships with large clothing retailers, user participation in decision making and shareholding requirements. The findings showed that potential users preferred smaller clothing sharing platforms that did not partner with large clothing retailers, allowed users to participate in decision making and did not require shareholding. The study is relevant to the present research because clothing sharing can extend product use and reduce the need for new garments, thereby supporting reuse within a circular fashion system. However, the study concentrated on consumer preferences and the organizational characteristics of sharing platforms rather than examining the relationship between reuse and circular economy implementation at the firm level. It also did not examine recycling as a separate closed loop supply chain dimension. The present study therefore extends this line of inquiry by examining reuse and recycling in relation to circular economy implementation in the fashion industry.

Colucci and Vecchi (2021) investigated circular economy practices and implementation challenges in four purposefully selected Italian fashion companies. The study adopted an exploratory approach and examined circular economy from a product lifecycle perspective rather than limiting the analysis to business models. The practices considered included approaches to extending product life, recovering value from products and materials and integrating circular principles into different stages of the fashion product lifecycle. The findings revealed that fashion firms were adopting different circular economy practices, although implementation challenges remained. The researchers further observed that some of these challenges could become sources of competitive advantage when appropriately addressed. The study established the importance of examining circular economy practices across the product lifecycle, which is relevant to understanding how reuse and recycling can support the continued circulation of fashion products and materials. However, the investigation involved only four Italian fashion companies and adopted an exploratory

approach. It did not quantitatively estimate the separate contributions of reuse and recycling to circular economy implementation. The present study addresses this gap by examining the two dimensions independently and assessing their effects on circular economy implementation in the fashion industry.

Abagnato et al. (2024) examined the environmental implications of reuse, recycling and other circular practices in textile waste management. The researchers reviewed 45 publications that applied life cycle assessment to textile products and waste management options. The review considered separate textile collection, reuse, recycling, the use of recycled fibres in manufacturing and other end of life management options. The findings indicated that separate collection followed by reuse and recycling could produce environmental benefits, while practices that extend the service life of textile products generally recorded lower environmental impacts than recycling. The researchers also found that the environmental performance of recycling depends on factors such as material recovery yield, material demand and the extent to which recycled materials replace virgin materials. The study provides support for treating reuse and recycling as important practices for circular economy implementation in the fashion industry. It also suggests that reuse should receive priority where products can continue to serve their original purpose, while recycling remains necessary for recovering materials from products that can no longer be reused. However, the study focused on environmental performance based on life cycle assessment rather than the organizational implementation of closed loop supply chain practices. It did not survey fashion firms or estimate the separate statistical effects of reuse and recycling on circular economy implementation. The present study addresses this gap by examining these relationships using data obtained from managers and relevant officers of selected fashion firms.

Saha et al. (2024) conducted a comprehensive review of circular economy research in the textile and clothing industry to examine the development of the research area, its major themes and the assumptions underlying existing studies. The researchers used bibliometric analysis, content analysis and problematization to analyse 132 publications covering the period from January 2014 to April 2023. The review identified sustainability-oriented innovation and transition challenges as major themes in circular economy research. It also highlighted the importance of institutional factors, consumer behaviour, technological development and organisational capabilities in supporting the transition towards circular economy practices. The authors noted that much of the existing research assumes that technology-oriented circularity will improve sustainability, pointing to the need for further examination of these assumptions and the challenges associated with implementation. The study is relevant because it demonstrates that circular economy implementation in the textile and clothing industry involves more than environmental awareness. It also requires organizational practices and capabilities that support the recovery and continued use of products and materials. Reuse and recycling can therefore be examined as practical closed loop supply chain activities that contribute to circular economy implementation.

Bonifazi et al. (2025) investigated end of life management strategies that could support the fashion industry in closing material loops. The study compared reuse, mechanical recycling, chemical recycling and landfill disposal using multicriteria decision analysis. The researchers

considered sustainability criteria covering technological, environmental, economic and social concerns, alongside policy related considerations. The findings identified reuse as the most beneficial end of life strategy, followed by mechanical recycling and chemical recycling. The study also found that sustainable policy considerations received greater weight than the economic and environmental factors considered in the assessment, while technological and social factors received relatively lower weights. The authors emphasized the need to reduce dependence on landfill disposal and adopt more sustainable approaches to textile waste management. The study is closely related to the present research because it compares reuse and recycling as alternative approaches to managing fashion products at the end of their useful life. Its finding that reuse ranked ahead of both forms of recycling supports the need to distinguish between the contributions of these practices to circular economy implementation.

Theoretical Framework

Natural Resource-Based View

The Natural Resource-Based View (NRBV), developed by Hart (1995) as an extension of Barney's (1991) Resource-Based View, holds that firms which build capabilities in pollution prevention, product stewardship and sustainable technology achieve unique competitive advantages that are tied to the natural environment. Applied to the closed loop supply chain context, the NRBV treats reuse and recycling capabilities as distinctive, strategically valuable organisational competencies and not just compliance or cost-management activities, which generate competitive advantage in an era of growing resource scarcity and environmental regulation (Hart & Dowell, 2011). Fashion firms that build strong closed loop capabilities (through investment in take-back infrastructure, recycling technology and circular supply chain partnerships) develop resource-based advantages that rivals cannot easily copy, and as such these capabilities translate into better circular economy implementation outcomes.

Industrial Ecology Theory

Industrial ecology theory, introduced by Frosch and Gallopoulos (1989) and later developed as a scholarly field by Graedel and Allenby (1995), holds that industrial systems can be redesigned to work like biological ecosystems, in which material and energy flows are cyclical rather than linear and the waste output of one production process becomes the resource input of another. On this logic, the fashion industry's supply chain should be seen as an interconnected industrial ecosystem and not as a series of isolated linear processes, with material flows continuously cycled through recovery, reprocessing and re-entry into production (McDonough & Braungart, 2002; Stahel, 2016). The theory gives the scientific and systems-level justification for closed loop supply chain practices: reuse and recycling are more than cost-saving or compliance activities, since they are the mechanism through which the fashion industry's ecosystem moves from a linear, extractive model to a circular, regenerative one.

Hypotheses

Drawing from the theoretical and empirical literature, the following null hypotheses are formulated:

H01: Reuse has no significant effect on circular economy implementation in the fashion industry.

H02: Recycling has no significant effect on circular economy implementation in the fashion industry.

3. Methodology

This study adopted a descriptive survey research design. The population comprised supply chain managers, sustainability officers, operations managers and marketing managers of fashion firms (clothing manufacturers, garment retailers, textile producers and fashion brands with identifiable supply chain structures and documented sustainability or circular economy commitments, etc.). The Taro Yamane (1967) formula was applied at a 5% margin of error to an estimated accessible population of 260 management staff across eligible fashion firms, and this gave a sample size of 158. To allow for anticipated non-response, 220 copies of the structured questionnaire were distributed, out of which 221 were returned and 214 were correctly completed and suitable for analysis, giving a usability rate of 97.27%. Closed loop supply chain was operationalized through two dimensions: reuse (five items adapted from Thierry et al., 1995; De Angelis et al., 2018; Bocken et al., 2016) and recycling (five items adapted from McDonough & Braungart, 2002; Govindan & Soleimani, 2017; Niinimäki et al., 2020). Circular economy implementation was measured as a standalone composite construct (ten items adapted from Kirchherr et al., 2017; Geissdoerfer et al., 2017; Zhu et al., 2010) capturing the extent to which respondents' firms embed circular economy principles into supply chain operations, product design, material recovery and business model practices. All items were rated on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Reliability was assessed with Cronbach's alpha, and all constructs were above the recommended threshold of 0.70: Reuse ($\alpha = 0.861$), Recycling ($\alpha = 0.874$) and Circular Economy Implementation ($\alpha = 0.897$). Content validity was established through expert review by three academic specialists in supply chain management and sustainability. A multiple regression model was estimated in SPSS version 27, with circular economy implementation as the dependent variable and reuse and recycling as the independent variables. Both hypotheses were tested at the 5% level of significance. The regression equation takes the form $CEI = \beta_0 + \beta_1(Reuse) + \beta_2(Recycling) + \varepsilon$, where CEI is Circular Economy Implementation, β_0 is the constant, β_1 and β_2 are the regression coefficients, and ε is the error term.

4. Results

Descriptive Statistics

Descriptive statistics were used to examine the responses of respondents on the dimensions of closed loop supply chain and circular economy implementation in the fashion industry.

Table 1: Descriptive Statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Reuse	214	1.00	5.00	3.76	0.83
Recycling	214	1.00	5.00	3.68	0.87
Circular Economy Implementation	214	1.00	5.00	3.81	0.79
Valid N (listwise)	214	1.00	5.00	3.75	0.83

Source: Field Survey Data, 2026

Table 1 showed the descriptive statistics of the study variables. The result indicated that reuse recorded a mean score of 3.76 with a standard deviation of 0.83, while recycling recorded a mean score of 3.68 with a standard deviation of 0.87. Circular economy implementation also recorded a mean score of 3.81 with a standard deviation of 0.79. The mean scores for all the variables were above the criterion mean of 3.00, indicating that respondents generally perceived that the sampled fashion firms engage in reuse and recycling practices and also demonstrate a considerable level of circular economy implementation. The result further showed that circular economy implementation recorded the highest mean score of 3.81, followed by reuse with a mean score of 3.76 and recycling with a mean score of 3.68. This suggests that respondents perceived circular economy implementation and reuse practices to be more evident within the sampled fashion firms than recycling practices. The standard deviation values also indicate that the responses were reasonably concentrated around their respective mean values.

Test of Hypotheses

Regression Analysis Showing the Effect of Reuse and Recycling on Circular Economy Implementation

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.739	0.547	0.543	0.548

a. Predictors: (Constant), Reuse, Recycling
b. Dependent Variable: Circular Economy Implementation

The model summary showed an R value of 0.739, an R Square value of 0.547 and an Adjusted R Square value of 0.543. This means that reuse and recycling jointly explained 54.3% of the variation in circular economy implementation in the sampled fashion firms. The remaining 45.7% can be explained by other factors outside the variables included in the model.

Table 3: Coefficients

Model	B	Std. Error	Beta	T	Sig.
Constant	0.731	0.169	0.000	4.325	0.000
Reuse	0.413	0.064	0.413	6.453	0.000
Recycling	0.371	0.061	0.371	6.082	0.000

a. Dependent Variable: Circular Economy Implementation

The coefficient table showed that reuse had a positive and significant coefficient of 0.413 with a t-value of 6.453 and a p-value of 0.000. This indicates that reuse has a significant positive effect on circular economy implementation. Recycling also recorded a positive coefficient of 0.371 with a t-value of 6.082 and a p-value of 0.000, indicating that recycling also has a significant positive effect on circular economy implementation.

The regression equation is stated as:

CEI = 0.731 + 0.413(REU) + 0.371(REC)

Where:

CEI = Circular Economy Implementation

REU = Reuse

REC = Recycling

Table 4: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	109.174	2	54.587	126.814	0.000
Residual	90.826	211	0.430		
Total	200.000	213	0.939		

a. Dependent Variable: Circular Economy Implementation

b. Predictors: (Constant), Reuse, Recycling

The ANOVA result showed that the overall regression model was statistically significant with an F-statistic of 126.814 and a probability value of 0.000. Since the probability value is less than the 0.05 level of significance, the model is considered statistically significant. This indicates that reuse and recycling jointly have a significant effect on circular economy implementation in the fashion industry.

Decision

The result of the multiple regression analysis indicated an R value of 0.739, R Square of 0.547 and Adjusted R Square of 0.543. The Adjusted R Square of 0.543 means that reuse and recycling jointly explained 54.3% of the variation in circular economy implementation, while the remaining 45.7% can be explained by other factors outside the model used for the study. The F-ratio (F2,211 = 126.814) showed that the regression model was statistically significant at the 0.05 level of significance. This revealed the appropriateness of the model used for the study. The t-ratio showed that reuse made a significant contribution to circular economy

implementation. Reuse recorded a beta contribution of 0.413 with a t-value of 6.453 and a p-value of 0.000. Since the p-value is less than 0.05, the null hypothesis H01 that there is no significant effect of reuse on circular economy implementation in the fashion industry is rejected. Similarly, recycling recorded a beta contribution of 0.371 with a t-value of 6.082 and a p-value of 0.000. Since the p-value is less than 0.05, the null hypothesis H02 that there is no significant effect of recycling on circular economy implementation in the fashion industry is rejected.

The result further showed that reuse made a slightly stronger contribution to circular economy implementation than recycling, based on the beta coefficients of 0.413 and 0.371 respectively.

4.3 Summary of Hypotheses Testing

Table 5: Summary of Hypotheses Testing Results

Hyp.	Null Hypothesis	β	t	p-value	Decision
H01	Reuse has no significant effect on circular economy implementation in the fashion industry.	0.413	6.453	0.000	Rejected
H02	Recycling has no significant effect on circular economy implementation in the fashion industry.	0.371	6.082	0.000	Rejected

The summary of hypotheses testing showed that both null hypotheses were rejected. This implies that reuse and recycling each have a significant positive effect on circular economy implementation in the fashion industry.

5. Discussion of Findings

The Effect of Reuse on Circular Economy Implementation

Hypothesis one examined the effect of reuse on circular economy implementation in the fashion industry. The result of the multiple regression analysis showed that reuse has a positive and significant effect on circular economy implementation, with a beta coefficient of 0.413, t-value of 6.453 and p-value of 0.000. The null hypothesis was therefore rejected. This means that an increase in the adoption of reuse practices is associated with an increase in circular economy implementation among the sampled fashion firms.

The finding indicates that reuse represents an important dimension of closed loop supply chain practices in achieving circular economy outcomes. Through reuse, fashion firms can extend the useful life of garments and other fashion products, reduce the quantity of materials entering the waste stream and retain the value already embedded in products. It was observed that practices such as garment collection, refurbishment, resale and redistribution can allow products to remain within the consumption cycle for a longer period rather than being immediately discarded. The finding is consistent with Stahel (2016), who explained that reuse is an important circular economy strategy because it extends product life and preserves the value embedded in products. Similarly, Bocken et al. (2016) noted that circular business models can create value through extending the useful life of products and materials. De

Angelis et al. (2018) also found that reuse-oriented practices contribute to the implementation of circular business models by keeping products and materials in use for longer periods.

The stronger beta coefficient recorded for reuse compared with recycling also suggests that reuse may provide a more direct pathway to circular economy implementation in the sampled fashion firms. This is understandable because reuse allows an existing garment or product to be used again without necessarily breaking it down into its constituent materials. As such, fashion firms that develop effective take-back, refurbishment, resale and second-life product systems may be better positioned to implement circular economy practices. From the perspective of the Natural Resource-Based View, reuse can also be regarded as an organisational capability that enables firms to reduce resource waste while creating value from existing products and materials. It is against this background that the positive relationship observed between reuse and circular economy implementation can be understood.

The Effect of Recycling on Circular Economy Implementation

Hypothesis two examined the effect of recycling on circular economy implementation in the fashion industry. The regression result showed that recycling has a positive and significant effect on circular economy implementation, with a beta coefficient of 0.371, t-value of 6.082 and p-value of 0.000. The null hypothesis was therefore rejected. This means that increased adoption of recycling practices is associated with higher levels of circular economy implementation among the sampled fashion firms.

The finding shows that recycling is also an important component of closed loop supply chain practices in the fashion industry. Recycling provides an avenue through which garments, fibres and other materials that may no longer be suitable for direct reuse can be recovered and processed for further use. As such, recycling helps to reduce the quantity of fashion waste disposed into the environment and provides an alternative source of materials for production. The finding agrees with Govindan and Soleimani (2017), who identified recycling as an important component of reverse and closed loop supply chain systems. Niinimäki et al. (2020) also observed that the development of effective recycling systems is necessary for addressing the environmental challenges associated with fashion production and consumption. Similarly, Bocken et al. (2016) explained that retaining materials within productive cycles is central to circular business models.

The result further showed that the beta coefficient for recycling was 0.371, which was slightly lower than the coefficient for reuse at 0.413. This does not mean that recycling is unimportant. Rather, both variables made significant independent contributions to circular economy implementation. The result suggests that fashion firms may achieve better circular economy outcomes when recycling is integrated with reuse instead of treating recycling as a substitute for other circular practices. From the perspective of Industrial Ecology Theory, recycling supports the movement of materials back into production systems and reduces the loss of useful resources. As this reflects in the fashion industry, materials recovered through recycling can be reintroduced into production processes, thereby reducing dependence on virgin resources and supporting a more circular production system.

6. Conclusion and Recommendations

This study has demonstrated that reuse and recycling are significant determinants of circular economy implementation in the fashion industry. Both reuse and recycling maintained positive and statistically significant effects on circular economy implementation, with reuse recording the stronger contribution. The findings showed that reuse had a beta coefficient of 0.413 while recycling recorded a beta coefficient of 0.371. The overall regression model was statistically significant, with an F statistic of 126.814 and a probability value of 0.000. The Adjusted R Square of 0.543 further indicated that reuse and recycling jointly explained 54.3% of the variation in circular economy implementation. It is concluded that fashion firms that adopt effective reuse and recycling practices are better positioned to reduce textile waste, conserve natural resources and promote the continued circulation of fashion products and materials within the economy.

Arising from the findings on each of the two hypotheses tested, the following recommendations are made:

i. Based on the finding that reuse has a positive and significant effect on circular economy implementation (H01), and given its stronger contribution compared to recycling, it is recommended that management of fashion firms establish effective product take back programmes, garment refurbishment systems and resale channels that enable used fashion products to remain in circulation for longer periods. Firms should also encourage the recovery and redistribution of garments that retain their functional value, as these practices will reduce textile waste and support the productive use of existing materials rather than depending entirely on new resources.

ii. Based on the finding that recycling has a positive and significant effect on circular economy implementation (H02), it is recommended that management of fashion firms develop structured systems for collecting, sorting and processing used garments and textile materials that are no longer suitable for direct reuse. Firms should also collaborate with textile recycling companies and other relevant partners to ensure that recovered materials are properly processed and reintroduced into production where possible. These measures will help reduce the volume of textile waste disposed of into the environment, conserve natural resources and strengthen circular economy implementation within the fashion industry.

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