
Developing A Digital Supply Coordination (DSC) Based Upcycling Repurposing Model: Optimizing the Margins of Circular Economy MSMEs in Padang Lawas Regency

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Abstract:

The transition toward a circular economy provides opportunities for Micro, Small, and Medium Enterprises (MSMEs) to increase the economic value of resources through upcycling and repurposing. However, their implementation continues to face several challenges, including uncertainty in raw material availability, weak coordination among supply chain actors, limited market-demand information, and the lack of digital integration among suppliers, producers, distributors, and consumers. These conditions may increase transaction and operational costs and consequently reduce MSME profit margins. This article aims to develop a conceptual framework for a Digital Supply Coordination (DSC) model to support upcycling repurposing activities and optimize the margins of circular economy MSMEs in Padang Lawas Regency. A conceptual approach is adopted by integrating literature on circular economy, upcycling, repurposing, supply chain digitalization, supply chain coordination, and MSME performance. The proposed model consists of five main components: digital resource mapping, digital supplier coordination, production coordination, digital market coordination, and margin optimization. Integrating these components is expected to improve information transparency, raw material supply certainty, production efficiency, distribution accuracy, market access, and MSMEs' ability to create added value from previously low-value materials. The conceptual novelty lies in integrating upcycling–repurposing practices with DSC, oriented not only toward environmental sustainability but also toward creating and optimizing MSME economic margins. The proposed framework provides a foundation for subsequent empirical testing among circular economy MSMEs in Padang Lawas Regency.

Keywords: Circular Economy; Digital Supply Coordination; MSME Margin; Repurposing; Upcycling.

Sumbitted: September 8, 2026, Accepted: October 14, 2026, Published: October 15, 2026

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1. Introduction

The transition from a linear economy toward a circular economy has become an important strategy for sustainable economic development by promoting resource efficiency, waste reduction, and economic value creation. Unlike the conventional *take–make–dispose* approach, the circular economy emphasizes maintaining the value of materials and products through reuse, recycling, upcycling, and repurposing. Circular business model innovation plays an essential role in integrating environmental sustainability with economic performance (Bocken & Konietzko, 2022; Bocken & Ritala, 2022). Furthermore, Susur and Engwall (2023) emphasized that transitioning toward circular business models requires systemic changes in business networks and organizational practices, while Kimaro et al. (2026) examined the mechanisms, drivers, and barriers associated with circular business models. These perspectives indicate that circular economy implementation requires not only resource recovery but also effective coordination, technological integration, and economically sustainable business operations.

Micro, Small, and Medium Enterprises (MSMEs) have significant potential to implement circular economy practices because of their operational flexibility, proximity to local resources, and ability to transform secondary materials into marketable products. Upcycling and repurposing provide opportunities to convert agricultural residues, manufacturing by-products, packaging materials, plastics, textiles, and other unused resources into products with enhanced functionality and economic value. Shi et al. (2022) examined the motivations underlying upcycling activities, while Triguero et al. (2023) explored the relationship between circular economy practices, product redesign, and firm performance. Nevertheless, MSMEs frequently encounter financial, technological, organizational, and market-related barriers when adopting circular business models (Cano-Rubio et al., 2021; Hina et al., 2022; Pangarso et al., 2022). Similar challenges have been identified by Kuik et al. (2023), Fontoura et al. (2024), and Marondera et al. (2026), highlighting the importance of integrated approaches that combine resource utilization, technological capabilities, and business sustainability.

Padang Lawas Regency, located in North Sumatra Province, Indonesia, represents a relevant context for circular economy development because its regional economy is predominantly supported by natural-resource-based sectors and manufacturing activities. According to Statistics Indonesia (BPS), the Gross Regional Domestic Product (GRDP) of Padang Lawas Regency at current prices reached IDR 18.33 trillion in 2024, while GRDP at constant 2010 prices amounted to approximately IDR 9.66 trillion. Regional economic growth was recorded at 5.02%, slightly lower than the 5.14% achieved in 2023. The economic structure in 2024 was dominated by agriculture, forestry, and fisheries, contributing 53.01%, followed by manufacturing at 16.32% and construction at 14.17%. Collectively, these three sectors accounted for approximately 83.50% of the regional economy. In 2025, GRDP at current prices

increased to approximately IDR 20.56 trillion, while GRDP at constant 2010 prices reached approximately IDR 10.06 trillion. However, economic growth slowed to 4.19%. Agriculture, forestry, and fisheries remained the dominant sector, contributing 54.63%, followed by manufacturing at 16.03% and construction at 13.25%, representing a combined contribution of approximately 83.91%. Meanwhile, transportation and warehousing recorded the highest sectoral growth rate of 8.81% in 2025. These economic characteristics indicate opportunities for developing circular economy activities through the utilization of agricultural residues, industrial by-products, packaging materials, and other secondary resources. Nevertheless, systematic mapping is required to determine the actual availability, quality, quantity, and distribution of these materials.

The increase in nominal GRDP from IDR 18.33 trillion in 2024 to IDR 20.56 trillion in 2025, accompanied by slower real economic growth, highlights the importance of exploring alternative mechanisms for regional value creation and economic diversification. Circular economy-based MSMEs may contribute to these objectives by transforming underutilized resources into differentiated products with additional market value. This direction is also relevant to regional initiatives supporting MSME development and entrepreneurship. The Padang Lawas Regency Government has encouraged the development of innovative village products and independent entrepreneurship through initiatives such as the MSME Gallery and the Family Income Improvement Program (UP2K) in Ujung Batu III Village, Hutaraja Tinggi District. In addition, collaboration involving BPS, the Office of Communication and Informatics, and the Office of Cooperatives, Industry, Trade, and MSMEs reflects efforts to strengthen sectoral information for regional economic development. However, transforming local resources into economically viable circular products requires effective coordination among material suppliers, collectors, processing MSMEs, distributors, and consumers.

One of the principal challenges in developing circular economy-based MSMEs is the fragmentation of supply chain coordination. Secondary materials used for upcycling and repurposing are often geographically dispersed, inconsistent in quality, and uncertain in availability. Limited information exchange among supply chain actors can increase procurement, transportation, storage, production, distribution, and transaction costs, thereby reducing potential business margins. Aarikka-Stenroos et al. (2022) emphasized the importance of supply chain collaboration in enabling circular business models, while Salvioni et al. (2022) highlighted the relevance of implementation and monitoring mechanisms. In the Indonesian context, Tseng et al. (2025) examined circular supply chain management and waste management practices among SMEs, reinforcing the importance of coordinated resource utilization. Furthermore, Cavicchi et al. (2022) demonstrated the role of resource and energy management in supporting circular business development. These findings suggest that successful upcycling–repurposing activities depend not only on material transformation but also on supply chain efficiency and economic viability.

Digital technologies offer opportunities to address these challenges by improving resource visibility, supplier connectivity, information exchange, production planning, and market coordination. Chauhan et al. (2022) and Massari et al. (2023) highlighted the potential of digital technologies to support circular economy implementation and resource-loop redesign. Similarly, Jum'a et al. (2024) proposed an Internet of Things-enabled framework for circular supply chain integration, while Steiner and Münch (2024) examined digital data spaces in circular purchasing and supply management. Other studies have explored the relationships among digital technologies, circular supply chain practices, operational performance, and sustainability (Dwivedi et al., 2024; Kiran, 2024; Trivedi et al., 2024; Winkelmann et al., 2024). Collectively, these findings suggest that digitalization can support circular supply chain integration when technological applications are aligned with operational requirements, resource management, and business objectives.

In Padang Lawas Regency, the importance of expanding digitalization beyond conventional marketing activities is supported by Harahap et al. (2024), who examined 97 MSME owners and found that access to finance significantly influenced MSME growth, whereas digital marketing did not demonstrate a significant effect. Financial literacy also did not significantly moderate the relationship between digital marketing and MSME growth. Although these findings do not establish the effectiveness of digital supply chain coordination, they indicate the relevance of exploring digital applications beyond promotional activities. Digitalization can potentially support material procurement, supplier coordination, inventory management, production scheduling, distribution, and cost monitoring. This broader perspective is particularly important because the economic viability of upcycling–repurposing depends on balancing value-added production with operational efficiency. Relatively inexpensive secondary materials do not necessarily generate higher margins when businesses face substantial costs associated with material collection, transportation, sorting, processing, storage, and marketing.

Despite the growing literature on circular business models and digital circular supply chains, the integration of digital resource mapping, supplier coordination, upcycling–repurposing production, market coordination, and margin optimization within a unified MSME-oriented framework remains insufficiently articulated in the reviewed studies. Existing research has examined circular business model innovation, implementation barriers, digital technology adoption, resource-loop redesign, and supply chain collaboration, but these dimensions have often been addressed separately. Furthermore, research concerning MSMEs in Padang Lawas has primarily examined financial access, digital marketing, and business growth, leaving limited understanding of how digital coordination can connect secondary resource utilization with operational cost efficiency, product value enhancement, and business margins. This gap highlights the need for an integrated framework that moves beyond *market-oriented digitalization* toward *supply-chain-oriented digitalization* while explicitly incorporating the economic sustainability of circular business activities.

To address this gap, this study proposes the Digital Supply Coordination for Upcycling–Repurposing Model (DSC-UR Model), integrating five interconnected components: Digital Resource Mapping, Digital Supplier Coordination, Upcycling–Repurposing Production Coordination, Digital Market Coordination, and the Margin Optimization System. The model is designed to connect material sources, suppliers or collectors, processing MSMEs, distributors, marketplaces, and consumers through coordinated digital information exchange. Digital Resource Mapping identifies secondary material availability and characteristics, while Digital Supplier Coordination facilitates material procurement and supplier connectivity. Upcycling–Repurposing Production Coordination aligns material availability with production requirements and value-added product development, whereas Digital Market Coordination connects finished products with market demand. The Margin Optimization System integrates procurement costs, production expenses, logistics efficiency, selling prices, and revenue information to support economically informed decisions. Through these interconnected mechanisms, DSC is positioned as an enabling mechanism that integrates material, information, market, and economic value flows to support circular business development.

The novelty of the proposed DSC-UR Model lies in combining digital circular supply chain coordination, upcycling–repurposing value creation, and margin-oriented decision-making within a single framework specifically designed for MSMEs. Rather than treating digitalization, circular production, and financial performance as independent activities, the model establishes a continuous coordination mechanism linking secondary resource availability, supplier relationships, production processes, market demand, and business margins. Accordingly, this study aims to develop a Digital Supply Coordination-based Upcycling–Repurposing Model for optimizing the business margins of circular economy MSMEs in Padang Lawas Regency, Indonesia. The study is expected to contribute theoretically by extending digital circular supply chain coordination toward an integrated, margin-oriented MSME framework and practically by providing a conceptual basis for improving resource utilization, supplier connectivity, production efficiency, market access, and sustainable regional economic development.

2. Theoretical Background

The Circular Economy and MSMEs

The circular economy is an economic approach that seeks to retain the value of products and materials within the economic system for as long as possible. This approach differs from the linear economy because used materials are not immediately treated as waste, but rather as resources that can potentially re-enter the economic cycle. In MSMEs, the circular economy can be implemented through waste reduction, material reuse, product repair, recycling, upcycling, repurposing, and the creation of business models based on the use of secondary resources. Successful implementation requires collaboration. MSMEs cannot practice the circular economy individually

because materials, information, markets, technology, and institutional support come from various actors.

Upcycling and Repurposing

Upcycling is the process of increasing the value of materials that previously had low economic value by transforming them into products with higher utility, aesthetic value, or selling value. This concept differs from conventional recycling. Recycling may convert materials back into raw materials, whereas upcycling emphasizes the creation of higher value. Repurposing, on the other hand, refers to the use of a product or material for a new function. In the context of MSMEs, this practice opens up opportunities for product innovation with relatively low raw material capital requirements. In economic terms, this can be formulated as:

$$\text{Circular Added Value} = \text{Value of New Product} - \text{Value of Initial Material}$$

The greater the ability of MSMEs to transform low-value materials into high-value products, the greater the potential for *circular value creation*.

Digital Supply Coordination

Digital Supply Coordination is a concept developed in this article to describe coordination among supply chain actors through the use of digital information and technology. DSC has three main principles:

visibility → connectivity → coordination.

Visibility refers to the ability of each actor to obtain information about materials, demand, production, inventory, and markets. *Connectivity* refers to the linkages among suppliers, MSMEs, distributors, consumers, the government, and other stakeholders. *Coordination* refers to the ability of actors to adjust their procurement, production, distribution, and marketing decisions based on the available information. Thus:

Digital Visibility → Supply Chain Connectivity → Supply Coordination → Operational Efficiency.

MSME Margins

Margin is one of the indicators of MSMEs' economic sustainability. In simple terms:

$$\text{Margin} = \text{Sales Revenue} - \text{Total Costs}$$

The margin ratio can be formulated as:

$$\text{Margin (\%)} = [(\text{Revenue} - \text{Total Costs}) / \text{Revenue}] \times 100\%$$

In the developed model, DSC is expected to affect margins through two main pathways. The first is cost efficiency, namely the reduction of costs related to material sourcing, procurement, transportation, inventory, transactions, marketing, and distribution. The second is value enhancement, namely an increase in selling value

through upcycling–repurposing product innovation, differentiation, quality, product information, and market access. Thus:

$$\text{Margin Optimization} = \text{Cost Efficiency} + \text{Value Enhancement}$$

3. Methodology

This article adopts a conceptual approach (*conceptual research*) to develop an upcycling repurposing model based on Digital Supply Coordination. The model was developed by synthesizing several domains of literature, including: (1) the circular economy; (2) upcycling and repurposing; (3) supply chain coordination; (4) supply chain digitalization; (5) MSMEs; and (6) value creation and business margins. This synthesis was used to identify the main constructs, the relationships among constructs, the value-creation mechanisms, and the configuration of a DSC model suited to the characteristics of MSMEs. The conceptual model is further intended to be validated through Focus Group Discussions with MSMEs, material suppliers/collectors, distributors, the regional government, village/district governments, MSME practitioners, academics, digital service providers, and other circular economy stakeholders.

4. Empirical Findings/Result

Architecture of the DSC Model

The proposed model consists of five main components:

1. Digital Resource Mapping (DRM)
The first stage is the digital mapping of resources. The system provides information on the type, quantity, quality, location, price, and availability timing of materials. Its main function is to transform *resource uncertainty* into *resource visibility*.
2. Digital Supplier Coordination (DSC-S)
The second component connects material suppliers/collectors with MSMEs. Coordination covers material requirements, volume, specifications, delivery schedules, prices, and locations.
3. Upcycling–Repurposing Production Coordination (URPC)
The available materials are then integrated into MSME production planning. At this stage, the following selection is made: Material → Upcycling/Repurposing Potential → Product Design → Production Requirements → Potential Selling Value.
MSMEs can choose the material-use alternative that yields the best combination of added value and cost.
4. Digital Market Coordination (DMC)
Upcycled and repurposed products are then connected to the market through digital mechanisms. Consumer demand information can be fed back into the

production and procurement stages so that MSMEs produce not only on the basis of material availability but also on the basis of market needs.

5. **Margin Optimization System (MOS)**

The final component is an economic evaluation mechanism. MSMEs compare: Selling price – material costs – production costs – logistics costs – marketing costs – transaction costs = margin. These data form the basis for decision-making to determine the products, suppliers, production volumes, and markets that deliver the best margins.

Model Flow

The model framework can be illustrated as follows:



Figure 1. Integrated Digital Supply Chain Model for Waste Upcycling, SME Coordination, and Value-Added Product Marketing

The model forms a closed-loop information and material flow, that is, a continuously circulating flow of materials and information.

Conceptual Propositions

Based on this framework, several propositions can be developed.

- P1** : Digital Resource Mapping increases the visibility and certainty of raw material availability for upcycling–repurposing MSMEs.
- P2** : Digital Supplier Coordination increases the efficiency of material procurement through improved information exchange between suppliers and MSMEs.
- P3** : Efficient supply coordination reduces MSMEs' transaction and operational costs.
- P4** : Upcycling–Repurposing Production Coordination enhances MSMEs' ability to create added value from resources of low economic value.
- P5** : Digital Market Coordination improves the fit between the products produced by MSMEs and market demand.
- P6** : Digital Supply Coordination increases MSMEs' cost efficiency and value creation.
- P7** : Cost efficiency and increased product value contribute to the margin optimization of circular economy MSMEs.

Conceptually, these relationships can be summarized as follows:

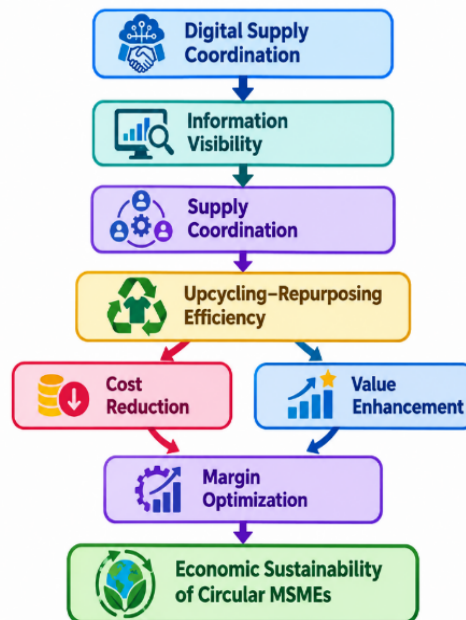


Figure 2. Conceptual Framework of Digital Supply Coordination for Margin Optimization and Economic Sustainability of Circular MSMEs

5. Discussion

The proposed Digital Supply Coordination for Upcycling–Repurposing (DSC-UR) Model extends the understanding of circular economy implementation by emphasizing that the sustainability of circular MSMEs depends not only on waste reduction and resource recovery but also on their ability to generate economic value and sustainable business margins. This perspective is consistent with Bocken and

Ritala (2022) and Bocken and Konietzko (2022), who emphasized the importance of integrating circular business practices with value creation and value capture. Similarly, Susur and Engwall (2023) highlighted the systemic transformation required for circular business models, while Kimaro et al. (2026) examined the mechanisms and barriers influencing their implementation. Unlike conventional supply chain approaches that primarily emphasize material distribution, the DSC-UR Model integrates material flows, information flows, market flows, and economic value flows into a coordinated circular business system. This integration is particularly important for upcycling–repurposing activities because secondary materials are often characterized by irregular availability, inconsistent quality, dispersed locations, and uncertain supply volumes.

The first important contribution of the DSC-UR Model concerns the integration of Digital Resource Mapping and Digital Supplier Coordination to address information fragmentation and procurement inefficiencies. Digital Resource Mapping is designed to improve transparency regarding the location, quantity, quality, availability, and price of secondary materials, potentially reducing search costs and procurement uncertainty. Digital Supplier Coordination subsequently connects suppliers, collectors, and MSMEs through structured information exchange, allowing material collection and distribution to be better aligned with production requirements. This mechanism is consistent with Aarikka-Stenroos et al. (2022), who emphasized the importance of supply chain collaboration in enabling circular business models, and Salvioni et al. (2022), who highlighted the role of implementation and monitoring mechanisms in circular business activities. Furthermore, Tseng et al. (2025) examined circular supply chain management and waste management practices among Indonesian SMEs, supporting the relevance of coordinated material management. Digital technologies may strengthen these mechanisms through resource traceability, information sharing, and supply chain integration, as discussed by Chauhan et al. (2022), Massari et al. (2023), and Steiner and Münch (2024).

The second contribution relates to Upcycling–Repurposing Production Coordination and Digital Market Coordination, which connect resource availability with production activities and consumer demand. Upcycling and repurposing should not be viewed merely as techniques for transforming discarded materials but as business processes that generate differentiated products with economic value. Shi et al. (2022) highlighted the behavioral dimensions of upcycling, while Triguero et al. (2023) examined the relationship between upcycling, product redesign, and firm performance. Within the DSC-UR Model, production decisions are informed by material availability, processing capabilities, product quality requirements, and market preferences. Digital Market Coordination enables consumer demand information to inform product development, helping MSMEs avoid producing environmentally beneficial products that lack sufficient market appeal. This mechanism reflects the importance of circular business model innovation discussed by Pangarso et al. (2022) and Kuik et al. (2023). Accordingly, the model combines *supply-driven circularity* with *market-driven circularity*, positioning

consumers as active participants in circular value creation rather than merely as final recipients of products.

The third contribution concerns the integration of Cost Efficiency and Value Enhancement as complementary mechanisms for MSME Margin Optimization. Although secondary materials may have relatively low acquisition costs, upcycling–repurposing activities can generate substantial expenses associated with material collection, sorting, transportation, storage, processing, design, and distribution. Consequently, resource recovery does not automatically translate into improved profitability. The DSC-UR Model proposes that digital coordination can potentially reduce avoidable operational costs through improved procurement information, supplier connectivity, production planning, and distribution efficiency. Simultaneously, upcycling–repurposing can enhance product value through innovation in design, functionality, quality, and differentiation. Cavicchi et al. (2022) highlighted the importance of resource and energy management in circular business development, while Kiran (2024) examined the relationships among circular supply chain practices, digital technology, and firm performance. Furthermore, Dwivedi et al. (2024) and Trivedi et al. (2024) emphasized the relevance of digital technologies for circular supply chain integration and performance improvement. Therefore, the proposed model conceptualizes margin optimization as the combined outcome of potential cost reduction and value enhancement rather than an increase in selling prices alone.

Another important implication of the DSC-UR Model is the role of Digital Supply Coordination as an enabling mechanism for Circular Value Creation. The model proposes that digital technologies contribute to circular business development by improving information visibility, strengthening supply chain coordination, and connecting secondary resource utilization with market opportunities. This perspective is consistent with Jum'a et al. (2024), who proposed an Internet of Things-enabled framework for circular supply chain integration, and Winkelmann et al. (2024), who examined digital technologies supporting sustainable and resilient supply chains. However, the proposed model does not assume that technological adoption automatically produces better economic outcomes. Its potential effectiveness depends on organizational readiness, digital capabilities, information quality, infrastructure availability, supplier reliability, and market accessibility. These implementation challenges are consistent with the barriers identified by Cano-Rubio et al. (2021), Hina et al. (2022), Fontoura et al. (2024), and Marondera et al. (2026). Thus, digital coordination should be understood as a facilitating mechanism whose contribution to business performance depends on the broader operational and institutional conditions of MSMEs.

The relevance of this model becomes particularly evident in Padang Lawas Regency, where the regional economy is dominated by agriculture, forestry, fisheries, manufacturing, and construction. In 2025, agriculture, forestry, and fisheries

contributed 54.63% of regional economic activity, followed by manufacturing at 16.03% and construction at 13.25%. These sectors collectively accounted for approximately 83.91% of the regional economic structure, indicating a substantial resource-based economic foundation. Although these figures do not directly establish the availability of reusable materials, they suggest opportunities for identifying agricultural residues, manufacturing by-products, packaging waste, and other secondary resources for circular MSME activities. Furthermore, Harahap et al. (2024) found that digital marketing did not significantly influence MSME growth in their study of 97 business owners in Padang Lawas Regency, suggesting the relevance of investigating broader digitalization approaches. The DSC-UR Model responds to this context by extending digitalization beyond marketing toward integrated resource mapping, supplier coordination, production management, distribution, and margin-oriented decision-making.

From a theoretical perspective, the DSC-UR Model contributes to the circular economy and digital supply chain literature by integrating digital coordination, circular value creation, and margin optimization within a unified MSME-oriented framework. Previous studies have examined circular business model innovation, organizational transition, technological integration, supply chain collaboration, and sustainability performance as important dimensions of circular economy implementation. The proposed model builds on these contributions by explicitly connecting five coordination components—Digital Resource Mapping, Digital Supplier Coordination, Upcycling–Repurposing Production Coordination, Digital Market Coordination, and the Margin Optimization System—into a continuous business process. Its distinguishing feature is the integration of cost-efficiency mechanisms and value-enhancement mechanisms into margin-oriented decision-making, with market and financial information feeding back into subsequent production planning. This conceptual integration provides a basis for examining how digital coordination may influence the economic sustainability of circular MSMEs.

From a practical perspective, implementing the DSC-UR Model requires collaboration among MSMEs, material suppliers and collectors, distributors, consumers, government institutions, academic institutions, and technology providers. Such collaboration forms a Digital Circular MSME Ecosystem in which different stakeholders contribute to resource identification, information exchange, production innovation, market connectivity, and business development. Government institutions can facilitate supporting policies, infrastructure, and capacity-building programs, while academic institutions and technology providers can contribute technical assistance, digital solutions, and business model development. MSMEs and supply chain partners remain central actors in implementing circular production and market coordination. Nevertheless, the proposed framework remains conceptual, and its effectiveness in reducing operational costs, enhancing product value, and improving business margins requires empirical validation. Future research should therefore examine implementation readiness, coordination performance, resource efficiency,

cost structures, product value, and actual business margins to establish the practical effectiveness and transferability of the DSC-UR Model.

Model Novelty

The conceptual novelty of this article can be formulated in three aspects. First, this study integrates upcycling and repurposing with digital supply chain coordination. Circular economy practices are positioned not merely as internal MSME activities, but as the outcome of coordination among various actors. Second, DSC integrates material flow and information flow within a circular system. Third, the success of the model does not stop at environmental indicators but is directed toward margin optimization. Thus, the main novelty can be stated as follows:



Figure 3. Conceptual Model of Upcycling–Repurposing, Digital Supply Coordination, and Circular Value Creation for MSME Margin Optimization

This framework is hereinafter referred to as the DSC-UR Model (Digital Supply Coordination for Upcycling–Repurposing).

6. Conclusions

This article develops the Digital Supply Coordination for Upcycling–Repurposing (DSC-UR) conceptual framework as an approach to integrating circular economy activities with digital supply chain coordination and MSME margin optimization. The model consists of five main components: Digital Resource Mapping, Digital Supplier Coordination, Upcycling–Repurposing Production Coordination, Digital Market Coordination, and the Margin Optimization System.

The integration of these components produces a *closed-loop* mechanism that links material availability, suppliers, MSME production, markets, and economic information. The main conceptual contribution of this study lies in the shift in orientation from mere waste reduction toward circular value creation. Upcycling–repurposing practices are positioned not only as an environmental strategy but also as an economic value-creation strategy.

Digital Supply Coordination functions as an *enabling mechanism* that increases information transparency and coordination among actors. Improved coordination is projected to generate cost efficiency and higher product value, which ultimately contribute to the optimization of MSME margins. The DSC-UR Model remains a conceptual framework and therefore requires validation and empirical testing. Future research could conduct FGDs with stakeholders, map MSME supply chains, measure cost and margin structures, and test the effectiveness of the model among circular economy MSMEs in Padang Lawas Regency. The results of such testing are expected to yield a DSC-UR Model that not only makes a theoretical contribution but can also be implemented as an instrument for developing circular economy MSMEs at the regional level.

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