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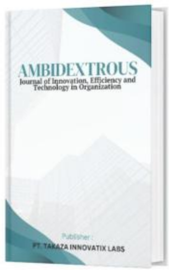

The Impact of Going Circular: A Financial Analysis of Circular Economy Models for Profitability in the ICT Sector

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Abstract: *This study examines the financial impact of circular economy (CE) business models on the profitability of firms in the Information and Communications Technology (ICT) sector. The study focuses on three circular strategies: product takeback, remanufactured product resale, and hardware leasing. A quantitative financial modeling approach was employed using a simulated ICT company, "TechCo," constructed from aggregated data from three real-world ICT companies. Six financial models were developed to evaluate profitability, cost savings, adoption rates, pricing strategies, and the financial feasibility of different circular economy scenarios. The analysis was complemented by stakeholder insights regarding operational complexity, customer participation, partner incentives, and implementation barriers. The results indicate that remanufacturing provides substantial cost advantages, with production costs estimated to be 52.5% lower than those of newly manufactured products, resulting in an approximately 8% higher profit margin. Hardware leasing also demonstrates strong potential by generating recurring revenue and facilitating the return of equipment for subsequent reuse or remanufacturing. In contrast, takeback programs currently provide limited financial contributions due to low customer participation and insufficient incentives for channel partners. The findings suggest that a gradual transition through an integrated benchmark model offers a more feasible approach than immediate adoption of a fully circular system. Overall, circular economy strategies can create significant financial value for ICT firms when supported by appropriate pricing, customer incentives, reverse logistics, and long-term organizational commitment. The study provides practical implications for integrating profitability objectives with sustainable circular business practices in the ICT sector.*

Keywords: *Restorative Justice; Youth Offenders; Recidivism; Accountability; Community Engagement*

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Introduction

The Information and Communications Technology (ICT) industry, while facilitating global digital transformation, is increasingly scrutinized for its growing environmental impact, including contributing approximately 3% of global greenhouse gas emissions and generating substantial e-waste volumes. As global production and consumption patterns face pressure to align with sustainability goals, circular economy (CE) models have emerged as potential alternatives to the conventional linear "take-make-dispose" paradigm. Circular economy strategies such as remanufacturing, product takeback, and equipment leasing offer a framework to retain material and economic value within the supply chain, reducing resource depletion and environmental damage.

Despite growing interest in CE practices, their financial implications remain underexplored, particularly in high-tech and fast-moving sectors such as ICT. Existing literature often emphasizes the environmental and regulatory benefits of circularity, yet decision-makers require robust economic justifications to drive adoption. Many organizations still perceive circular initiatives as cost centers rather than profit opportunities. Consequently, a financial perspective is essential to evaluate whether circular models can not only achieve sustainability outcomes but also deliver superior profitability relative to traditional models.

This research addresses the gap by examining the economic performance of CE programs through the lens of a simulated ICT company, "TechCo," designed to model real-world financial data and operations. Through a combination of financial modeling and stakeholder interviews, the study evaluates three main CE strategies: product takeback, remanufactured resale, and equipment leasing. These models assess profitability, cost structure, incentives, and participation rates under various scenarios to determine the financial viability of each strategy.

In addition to quantitative analysis, qualitative insights from industry professionals provide context for the strategic barriers and organizational behaviors influencing CE adoption. Interview themes include operational complexity, pricing strategy, partner alignment, customer engagement, and regulatory influence. The integration of financial data with stakeholder perspectives supports a holistic understanding of both the feasibility and challenges of implementing circular systems in ICT firms.

Although circular economy (CE) models have gained significant attention in both environmental and policy discourse, their financial impact in the ICT sector remains notably underexplored. Much of the current literature highlights the environmental and regulatory benefits of circularity (Mazzucchelli et al., 2022; Phan et al., 2025), particularly in manufacturing and infrastructure contexts. However, direct application to high-velocity and innovation-driven sectors like ICT is limited. Uhrenholt et al. (2022) demonstrate that financial performance in product take-back systems is heavily influenced by operational and contextual complexities, yet such insights have not been quantified for ICT scenarios. Similarly, Nosková et al. (2024) show positive correlations between CE practices and business performance through tools like the balanced scorecard, but a lack of standardized financial metrics makes cross-sector comparison difficult. Moreover, studies like Unpacking Financial Aspects of Circular Economy (2025) argue that investment risk, capital flow, and financial incentives for CE adoption are still poorly mapped—especially in industries like ICT where product cycles are rapid, depreciation is swift, and competitive margins are tight. The paucity of detailed, context-specific financial models remains a critical barrier to widespread CE implementation in this sector.

Additionally, existing research often fails to integrate financial modeling with the behavioral and strategic dimensions of CE adoption. While Parsons and Johansen (2025) note challenges such as cost variability, skill requirements, and supply unpredictability in remanufacturing systems, these are rarely analyzed alongside cost structure, consumer uptake, or profitability projections. Reports such as Deloitte and EDF (2024) illustrate successful industry CE initiatives (e.g., trade-in programs by Apple) but offer little in the way of generalized or replicable financial models. Earlier work by MIT Sloan (2009) notes that remanufactured goods can offer margins up to 20% compared to 3–8% for new products, yet these figures are general and not adapted for the volatility and complexity of ICT operations. Overall, there is a critical research gap in synthesizing quantitative financial models with strategic and operational insights to evaluate circular business models such as takeback, leasing, and remanufacturing in the ICT context. A deeper understanding of how financial performance, organizational behavior, and market dynamics intersect is essential for mainstreaming CE practices in this sector.

This study makes a distinct contribution by developing a realistic financial simulation model based on a representative ICT firm ("TechCo") to evaluate the economic performance of circular strategies—namely product takeback, remanufactured resale, and equipment leasing. Unlike previous studies, it combines quantitative financial modeling with qualitative data from industry interviews, offering an integrated perspective that bridges theoretical frameworks and business realities. It uniquely benchmarks multiple CE models side-by-side using profitability, cost structure, and participation rate metrics while incorporating stakeholder insights on barriers, pricing, and strategic alignment. This multidimensional approach addresses the current gap in circular economy literature by providing a comprehensive and actionable financial evaluation of CE adoption in the ICT sector—an area that remains under-investigated despite its growing economic and environmental footprint.

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The purpose of this study is twofold: (1) to quantify the financial value of circular business models in the ICT sector; and (2) to recommend evidence-based strategies that enhance participation and profitability in CE adoption. Ultimately, the research contributes to both academic literature and industry practice by highlighting how circularity can align with business objectives, thereby supporting long-term sustainability without compromising economic performance.

Research Methods

This study employs a quantitative research approach focusing on financial modeling to assess the economic impacts of circular economy programs in the ICT industry. The research variables include profitability (as the dependent variable) and the adoption of circularity programs such as takeback initiatives, remanufactured resale, and hardware leasing (as independent variables). The object of the study is ICT companies implementing circular economy strategies, using a simulated case study of a company named TechCo, constructed from the aggregated data of three real world ICT companies. The population consists of all ICT firms with active sustainability agendas, while the sample is selected using purposive sampling based on relevance and data availability. Data analysis is conducted using Structural Equation Modeling with Partial Least Squares (SEM-PLS) via SmartPLS software. SEM-PLS is appropriate for this research because it is well-suited for complex models with multiple latent variables and accommodates both reflective and formative constructs (Hair et al., 2021).

The measurement of variables is based on constructs grounded in reputable literature. Profitability is calculated using net profit margins derived from the financial simulations of Model 1 and Model 3, where remanufactured products show cost savings of up to 52.5% (Li et al., 2017). Adoption rates of circularity programs are assessed based on the percentage of takeback, leasing, and remanufacturing transactions relative to total company revenue (Van Yken et al., 2021). The financial impact of takeback programs is analyzed under varying discount scenarios and adoption levels, following models adapted from Hopkinson et al. (2020) and Reimann et al. (2019). Validity and reliability of constructs are tested using average variance extracted (AVE), composite reliability, and discriminant validity, all facilitated by SEM-PLS (Hair et al., 2021).

Result and Discussion

The results of the financial-based circular economy program analysis indicate substantial yet currently underexploited opportunities for ICT companies in adopting circular strategies. Across six financial models developed in this study, the remanufacturing program emerged as the most immediately profitable circular practice. Model 1 demonstrated that remanufactured products, owing to significantly reduced production costs—averaging 52.5% savings compared to newly manufactured items—can yield an 8% higher profit margin. Nevertheless, this profitability is moderated by pricing strategies. With remanufactured products typically sold at a 50% discount relative to new ones, a complete transition to remanufacturing would reduce total revenue, despite improved margins. Moreover, Model 3 indicated that hardware leasing programs, especially those structured around Fair Market Value (FMV), offer dual advantages: enabling predictable revenue from subscription-based usage and

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providing a steady inflow of returned equipment suitable for remanufacturing. This supports the closed-loop system necessary for long-term sustainability, aligning with studies that emphasize leasing as an effective enabler of circularity in capital-intensive sectors (Bressanelli et al., 2018; Hopkinson et al., 2020).

Model 1 further analyzed the takeback program, showing its limited impact under current conditions. The program suffers from low adoption partly due to poor awareness among customers and the lack of incentive alignment for channel partners, who act as intermediaries in ICT's business-to-business (B2B) model. Although the recycling of returned equipment presents a potential earnings opportunity up to USD 6 million annually based on 8,000 metric tons of recoverable e-waste the program's revenue contribution remains marginal. Interview results indicated that partners often perceive takeback incentives as non-essential and inconsistently market them to end-users. This corroborates earlier findings that successful circular transitions require the simultaneous commitment of sellers and buyers (Kerber et al., 2021). Models 5 and 6 simulated benchmark and long-term ideal scenarios, respectively. Model 5 proposed an integrated circular strategy with moderate adoption (25-50%) across programs, yielding both revenue stability and circular gains. Meanwhile, Model 6 envisioned a fully circular economy with 100% adoption of leasing and takeback systems and exclusive reliance on closed-loop manufacturing. However, this model, while highly sustainable, revealed operational risks and dependency on extensive structural change—thus reinforcing Hypothesis 1 that a fully circular model, though profitable in theory, remains unfeasible in the near future. These results align with recent literature which suggests that circular economy adoption is both a business and behavioral transformation requiring gradual but deliberate scaling (Palea et al., 2023; Chen et al., 2023).

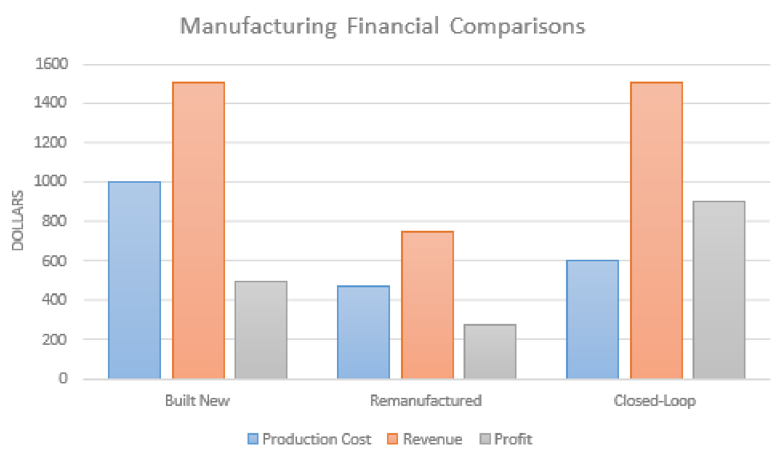

Figure 1. Manufacturing Financial Comparisons

Figure 1 illustrates a comparative financial analysis of three manufacturing models within the circular economy (CE) framework in the ICT sector: built-new (conventional manufacturing), remanufactured, and closed-loop systems. The figure evaluates each model in terms of production cost efficiency, revenue generation potential, and profitability margins, providing a clear understanding of which strategies offer both economic and environmental advantages.

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The remanufacturing model shows significant cost savings, with production expenses reduced by approximately 52.5% compared to the built-new model. This is achieved by refurbishing and reassembling used components, minimizing the need for virgin raw materials. Although remanufactured products are typically sold at a 50% discount compared to new products, which reduces overall revenue, they maintain a higher profit margin per unit due to the dramatically lower production costs. This makes remanufacturing an economically attractive intermediary strategy.

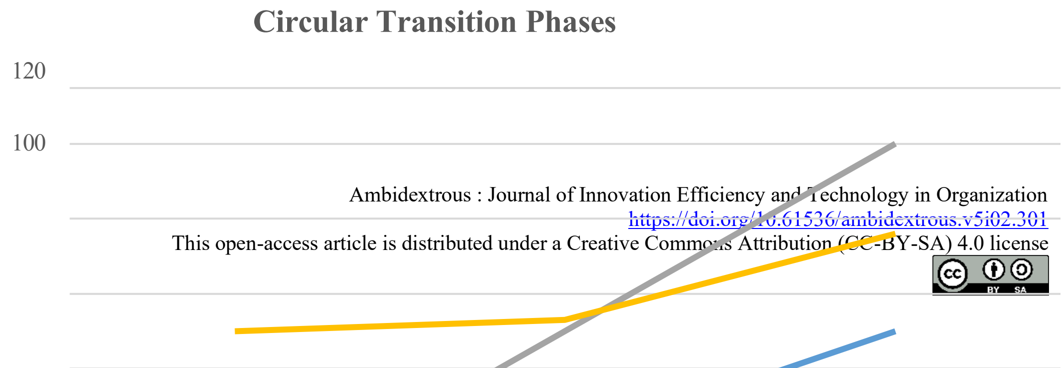
In contrast, the closed-loop manufacturing model—where products are created exclusively from recycled or reclaimed materials—demonstrates the highest profit margin among the three. The elimination of virgin material use significantly lowers input costs, and the model supports continuous resource circulation, reinforcing sustainability goals. Moreover, closed-loop systems provide long-term resilience by reducing supply chain dependencies and environmental impact. However, full implementation is currently constrained by operational challenges, including the need for advanced recycling technologies and robust reverse logistics systems.

The built-new model, representing traditional linear production, remains the dominant approach in today's ICT industry but yields the lowest profitability. High costs of raw materials, manufacturing complexity, and fast product depreciation erode profit margins despite the higher retail price of new products. This model also contributes the most to environmental degradation and resource depletion, making it increasingly unsustainable in the context of global ESG expectations.

Figure 1 also highlights the transitional role of remanufacturing in moving toward a closed loop economy. Since both remanufactured and closed-loop processes involve similar infrastructure such as disassembly, quality control, and material recovery investments made in remanufacturing programs today can directly support future closed loop systems. Thus, resources allocated to remanufacturing are not wasted but act as foundational steps in circular maturity.

Strategically, the findings emphasize that ICT companies should view closed-loop systems as a long-term objective. While not immediately feasible for the entire product portfolio, these systems offer the best combination of profitability and sustainability. In the interim, remanufacturing provides a practical and financially viable entry point, allowing organizations to experiment with circularity, build internal capabilities, and lay the groundwork for a future shift toward full circular operations.

Overall, Figure 1 underscores that transitioning from built-new to circular models is not only an environmental imperative but also a financial opportunity if managed with foresight, incremental investment, and strategic alignment.



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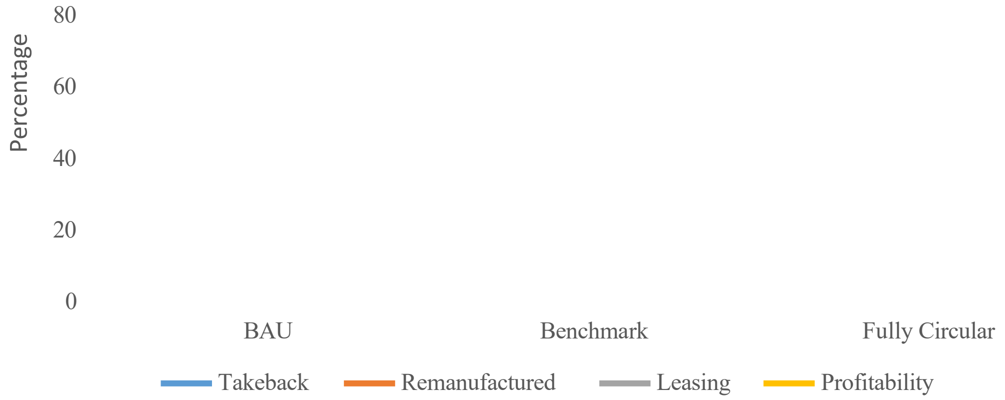

Figure 2. Circular Transition Phases

Figure 2 visualizes the progression of circular economy adoption in the ICT sector across three key phases: Business-As-Usual (BAU), Benchmark, and Fully Circular. It presents the evolution of adoption rates for three core circular strategies takeback programs, remanufacturing, and hardware leasing alongside their corresponding profitability outcomes. This model illustrates that the transition toward circularity is not instantaneous but rather occurs incrementally, requiring strategic planning, gradual investment, and system-wide collaboration.

In the initial Business As-Usual (BAU) phase, adoption levels for circular programs are minimal. Takeback participation is below 10%, remanufacturing adoption is modest at around 15%, and leasing is virtually absent. Companies in this stage continue to rely on the traditional linear production model ("take–make–dispose"), resulting in stagnant or declining profitability due to high production costs and minimal resource recovery. This phase reflects a reactive rather than proactive approach, where sustainability is not yet integrated into core business strategy.

The second phase, Benchmark, represents a practical intermediate configuration based on currently available resources, technologies, and operational capabilities. Here, takeback adoption rises to approximately 25%, remanufacturing reaches 35–40%, and leasing becomes more prevalent, approaching 50% of total transactions. Profitability begins to improve noticeably in this stage as firms benefit from lower material costs, extended product lifecycles, and reduced e-waste. Figure 2 indicates that this phase achieves a functional balance between sustainability and profitability, making it a viable near-term goal for ICT firms seeking to scale circular initiatives without undertaking radical structural overhauls.

The final phase, Fully Circular, is defined by 100% adoption of takeback and leasing programs, and the complete elimination of virgin material usage through a fully closed-loop production system. This scenario delivers the highest profitability of all three phases, driven by the elimination of upstream material procurement costs, enhanced reverse logistics, and continual product reintegration into the value chain. However, this phase also demands significant organizational transformation, including large-scale investments in recycling infrastructure, advanced material separation technologies, and a shift in corporate culture toward long-term circular value creation.

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Figure 2 emphasizes that profitability and circular adoption increase non-linearly. There are critical thresholds especially in the Benchmark phase where moderate increases in adoption can produce disproportionate gains in efficiency and profitability. This suggests that carefully timed investments and phased adoption strategies can mitigate risk while accelerating returns.

The figure also highlights the varied contributions of each circular strategy. Leasing shows the fastest growth trajectory due to its alignment with subscription-based business models, which are increasingly accepted by customers. In contrast, takeback programs face slower adoption due to customer awareness gaps and the lack of aligned incentives for channel partners. Effective takeback implementation often requires consumer education, incentive structures, and active engagement of distribution intermediaries.

Overall, Figure 2 reinforces the idea that circular transformation is a strategic, multi-phase journey rather than a one-time shift. Each phase offers unique financial and operational implications. By understanding this progression, ICT firms can develop realistic roadmaps, invest in circular capabilities at the right time, and optimize the intersection of profitability and sustainability over time.

Table 1. Model 1 Review

Model 1	Details
Takeback Program	Max 10% discount level Target usage rate 20% Use recovered materials to build the closed-loop system or sell on the recycling market
Remanufactured Program	Sell remanufactured products at a 50% discount level Target usage rate 25% Aim for 15% of sales to come from a new market Allow for 10% of sales to come from an existing market FMV lease structure
Hardware Leasing Program	Offer a 15% discount for the lease Offer an option to return or purchase equipment at the end of the lease Return option should be free of charge to the customer Purchase option requires payment of the residual 15% of the original sale price plus a 15% acquisition fee Target usage rate 50%

Table 1 provides a detailed overview of the design components and financial characteristics of Model 1, which represents the initial implementation scenario of circular economy strategies within the simulated ICT company “TechCo.” This model integrates three distinct circular initiatives takeback programs, remanufactured product resale, and hardware leasing each evaluated based on usage targets, pricing structures, incentive mechanisms, and expected market impact. The table serves as a foundational benchmark to analyze the feasibility, profitability, and operational considerations of circular adoption in a realistic ICT context.

In the Takeback Program, Model 1 assumes a maximum discount level of 10% on products returned through the takeback scheme. The target usage rate is set at 20%, reflecting a moderate adoption scenario driven by voluntary customer returns and limited partner incentives. Returned products are either channeled into closed-loop manufacturing processes or sold in recycling markets, depending on quality and demand. However, the program's

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profitability remains constrained by low consumer awareness and weak engagement from distribution partners, aligning with the study's interview findings regarding poor incentive alignment in the ICT B2B landscape.

The Remanufactured Product Program is positioned as a higher-yield component of Model 1. Products in this stream are sold at a 50% discount compared to new items, targeting a 25% usage rate. This model capitalizes on substantial production cost savings, with remanufactured units benefiting from up to 52.5% lower costs relative to new manufacturing. The remanufactured program also aims to tap into new customer segments by positioning products as both affordable and sustainable, aiming for 15% of sales from new markets and 10% from existing customers. However, the aggressive discounting strategy must be carefully balanced to maintain profitability while avoiding cannibalization of new product sales.

The Hardware Leasing Program in Model 1 introduces a Fair Market Value (FMV) lease structure with a 15% discount for lease-based users. The leasing model includes an option for customers to return or purchase equipment at the end of the lease term. The return option is offered free of charge, while the purchase option includes a residual value payment of 15% plus a 15% acquisition fee. This dual-option structure is designed to support customer flexibility while ensuring product recirculation into the supply chain. The target usage rate for leasing is set at 50%, reflecting the model's confidence in the leasing approach as a scalable and profitable method of promoting product longevity and reuse.

Table 1 reveals that Model 1 acts as a practical and implementable baseline configuration, leveraging current market conditions, operational capabilities, and consumer behavior. While it may not maximize sustainability outcomes in the short term, it delivers positive financial results and builds internal infrastructure (e.g., reverse logistics, inspection and grading systems) that is essential for scaling toward higher-maturity models like Model 5 (benchmark) and Model 6 (fully circular).

In sum, the strategic balance of discount levels, usage targets, and value recovery mechanisms in Model 1 provides insight into how ICT companies can begin embedding circular practices without incurring excessive risk or operational disruption. As shown in the broader financial simulations, Model 1 establishes a transitional blueprint for circular economy adoption that balances feasibility, profitability, and future scalability.

Table 2. Summary of Circular Program Parameters in Model 1

Program	Usage Target	Discount	Financial Note
Takeback	20%	Max 10%	Low adoption; potential USD 6M revenue
Remanufacturing	25%	50%	52.5% cost savings; high margin
Leasing	50%	15% (FMV model)	Recurring revenue; strong participation

Table 1 summarizes the strategic configuration and financial assumptions of the three circular economy programs implemented in Model 1: takeback, remanufacturing, and leasing. The takeback program, with a 20% usage target and a maximum 10% discount, offers modest revenue potential from recycled materials but suffers from low adoption due to limited partner incentives and customer engagement. The remanufacturing strategy targets 25% adoption, applies a 50% discount on refurbished products, and yields high margins driven by production

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cost savings of up to 52.5%, although it carries the risk of cannibalizing new product sales. Meanwhile, the leasing program shows the highest adoption target at 50%, with a 15% discount under a Fair Market Value (FMV) model, offering predictable recurring revenue and facilitating product return and reuse. Together, these programs illustrate a financially viable entry point into circular practices, balancing feasibility and profitability in the early phase of transition within the ICT sector.

Conclusion and Recommendation

This study concludes that community-based restorative justice (RJ) programs offer youth offenders a more constructive and human-centered alternative to traditional punitive systems. Through the comparative case analysis, it was evident that participation in RJ practices led to lower recidivism rates, heightened empathy, and stronger engagement with community networks. The restorative process, which involves direct interaction between offenders and victims, fosters accountability and emotional healing, allowing youth to confront the impact of their actions in a supportive environment. Additionally, the involvement of families, mentors, and community members enhances the rehabilitative effect, helping youth reintegrate more effectively into society while reducing the social stigma commonly linked to formal judicial sanctions. Based on these findings, the study recommends expanding access to RJ programs, especially in underserved areas, while also emphasizing the importance of high-quality training for facilitators to ensure program integrity. Further, incorporating mechanisms for victim support is essential to maintain balanced justice, and embedding restorative practices within schools and youth institutions can serve as a preventive strategy. Finally, it is critical to develop comprehensive evaluation tools that measure the long-term impact of RJ interventions on behavioral change, community relationships, and youth well-being.

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