

***DESIGN OF FABRIC WASTE MANAGEMENT INFORMATION SYSTEM FOR
CIRCULAR ECONOMY NONPROFITS***

**PERANCANGAN SISTEM INFORMASI PENGELOLAAN LIMBAH
PAKAIAN UNTUK ORGANISASI NIRLABA EKONOMI SIRKULAR**

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ABSTRACT

Textile waste management based on the circular economy still faces challenges related to material flow documentation, distribution accountability, and stakeholder coordination, particularly within nonprofit organizations. This study aims to design and develop the SILAHKAN information system as a solution to support structured, transparent, and sustainable textile waste management. The research adopts applied research with a qualitative descriptive approach combined with system development research. Data were collected through interviews, observations, documentation, and literature review. System development was conducted using the Agile Software Development method, encompassing problem identification, requirements analysis, system design, iterative development, testing, and user based evaluation. The results indicate that the SILAHKAN system supports textile waste flow recording, improves distribution traceability, and strengthens the role of nonprofit organizations as key actors in circular economy implementation. The system is expected to serve as an adaptive and practical information technology based model for textile waste management in nonprofit organizations.

Keywords: *Circular Economy, Textile Waste, Nonprofit Organization, Information System, Agile Software Development*

ABSTRAK

Pengelolaan limbah tekstil berbasis ekonomi sirkular masih menghadapi tantangan terkait dokumentasi aliran material, akuntabilitas distribusi, dan koordinasi pemangku kepentingan, khususnya dalam organisasi nirlaba. Studi ini bertujuan untuk merancang dan mengembangkan sistem informasi SILAHKAN sebagai solusi untuk mendukung pengelolaan limbah tekstil yang terstruktur, transparan, dan berkelanjutan. Penelitian ini mengadopsi penelitian terapan dengan pendekatan deskriptif kualitatif yang dikombinasikan dengan penelitian pengembangan sistem. Data dikumpulkan melalui wawancara, observasi, dokumentasi, dan tinjauan pustaka. Pengembangan sistem dilakukan menggunakan metode Agile Software Development, yang meliputi identifikasi masalah, analisis kebutuhan, desain sistem, pengembangan iteratif, pengujian, dan evaluasi berbasis pengguna. Hasil menunjukkan bahwa sistem SILAHKAN mendukung pencatatan aliran limbah tekstil, meningkatkan ketertelusuran distribusi, dan memperkuat peran organisasi nirlaba sebagai aktor kunci dalam implementasi ekonomi sirkular. Sistem ini diharapkan dapat berfungsi sebagai model berbasis teknologi informasi yang adaptif dan praktis untuk pengelolaan limbah tekstil di organisasi Nirlaba.

Kata Kunci: *Ekonomi Sirkular, Limbah Tekstil, Organisasi Nirlaba, Sistem Informasi, Pengembangan Perangkat Lunak Agile*

INTRODUCTION

The rapid growth of the global fashion industry has significantly transformed consumption patterns in contemporary society. Accelerated trend cycles, amplified by social media and digital platforms, encourage consumers to purchase new clothing frequently in order to keep pace with changing styles. This condition has intensified the practice of fast fashion, which is

characterized by the mass production of low cost garments with relatively short lifespans.

The dominance of fast fashion culture has resulted in overconsumption behavior and a substantial increase in textile waste generation. Studies indicate that consumers discard up to 50% of their clothing within a single year (Islam et al., 2025). This phenomenon contributes significantly to

the rising volume of textile waste at both global and national levels, creating environmental challenges due to the complexity of textile materials and limited recycling capacity.

At the global level, Fibre2Fashion reports that approximately 18.6 million tons of textile waste are disposed of in landfills annually (Asyhuri & Noorrizki, 2024). Furthermore, The Sustainable Fashion Forum projects a 63% increase in global clothing consumption by 2030, potentially resulting in textile waste accumulation reaching 300 million tons by 2050 (Syahla, 2025). These projections demonstrate that textile waste management will become increasingly complex if not addressed through systematic and technology supported approaches.

Indonesia faces similar challenges in managing textile waste. According to data from the National Development Planning Agency (Bappenas) in 2021, Indonesia generates approximately 2.3 million tons of clothing waste per year, accounting for around 12% of household waste, while only a small proportion is recycled (Pangesti et al., 2023). In addition to solid waste accumulation, the fashion industry contributes to environmental degradation through greenhouse gas emissions, water pollution, and microplastic release from synthetic textiles.

Various initiatives have been implemented to mitigate the impact of textile waste, including the development of recycling technologies and regulatory policies restricting the import of second hand clothing. However, these efforts remain constrained by high technological costs, limited recycling infrastructure, industrial overproduction, and low public awareness regarding clothing waste sorting and management.

These conditions highlight the need for more sustainable and integrated approaches to textile waste management. The circular economy concept offers a relevant framework by viewing waste as a resource that can be reintroduced into production and consumption cycles through reduce, reuse, and recycle strategies (Ghiffari et al., 2021). Within this framework, non profit organizations play a strategic role in textile waste collection, processing, redistribution, and community education. Nevertheless, many non profit organizations still rely on manual and fragmented processes that are not supported by integrated information systems capable of providing transparency, accountability, and measurable impact.

Advances in information technology offer opportunities to address these limitations through the development of textile waste management information systems that support systematic recording, monitoring, and evaluation of material flows. Therefore, this study focuses on the design and development of the Fabric Waste Management Information System (SILAHKAN) for circular economy based non profit organizations. The system is intended to support textile waste reduction efforts and contribute to the achievement of the Sustainable Development Goals (SDGs), particularly SDG 12 on responsible consumption and production.

Based on the background above, the research questions are formulated as follows:

1. How can a fabric waste management information system (SILAHKAN) be designed to support the operational activities of circular economy based non profit organizations?

2. What key features and components are required to monitor fabric waste collection, record recycling and distribution processes, and evaluate environmental and social impacts?
3. How can the Agile Software Development method be effectively applied in the design and development of this information system?

Accordingly, the objectives of this study are to:

1. Design a fabric waste management information system (SILAHKAN) that meets the operational needs of circular economy based non profit organizations.
2. Identify essential system features and components to support monitoring of collection activities, recording of recycling and distribution processes, and evaluation of environmental and social impacts.
3. Apply the Agile Software Development method in the design and development of the SILAHKAN system to ensure adaptability, iterative improvement, and alignment with user needs.

The expected contributions of this research include:

1. Academic contributions, by providing a reference for the development of circular economy based textile waste management information systems using Agile Software Development and enriching the literature on information systems for non profit organizations.
2. Practical contributions for non profit organizations, by delivering an information system that enhances transparency, efficiency, and accountability in fabric waste management activities.
3. Societal and governmental contributions, by offering a replicable information system model

that can be adopted by local governments or community organizations to support sustainable textile waste management.

LITERATURE REVIEW

The rapid expansion of the global fashion industry over the past decade has led to a significant increase in textile consumption, resulting in textile waste volumes that are increasingly difficult to manage. Unmanaged textile waste contributes to environmental degradation and exacerbates air pollution, particularly in areas with dense textile production activities (Umami & Tsani, 2024). From a reuse perspective, textile waste retains considerable economic value when reprocessed into creative and functional products. Similarly, Putri and Widiawati (2020) observe that many small scale household textile production areas have limited waste processing capacity, causing textile waste to remain underutilized or unmanaged (Khasna et al., 2020). These findings emphasize the urgency of waste management approaches that not only mitigate environmental impacts but also transform waste into valuable resources.

However, these studies primarily emphasize creative reuse outcomes rather than the systemic design required to connect stakeholders across collection, processing, and redistribution stages. This indicates that although the potential value of textile waste is widely acknowledged, mechanisms linking households, non profit organizations, and downstream users remain fragmented and unsystematic.

The circular economy framework has therefore emerged as a relevant conceptual approach. Emphasizes the importance of maintaining materials within economic cycles for as long as

possible through reuse and recycling strategies (Ryan Abdul Muhit, 2022). extend this concept through the 9R framework consist of refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover; demonstrating practical steps for waste reduction through production process redesign (Hadi et al., 2025). Despite its conceptual robustness, the implementation of circular economy principles in the textile sector particularly at the MSME and community organization levels remains limited due to inadequate data infrastructure and insufficient information systems to connect material flows among stakeholders.

Several studies have explored the integration of digital technology and circular economy principles. Developed a circular economy based fashion waste management application and demonstrated its potential to support SDG 12 on responsible consumption and production (Aulia et al., 2023). Nevertheless, the study focused on a specific urban context and did not position non profit organizations as central actors in community level textile waste mobilization. In practice, non profit organizations possess advantages in social organization and trust building that are critical for household level waste collection.

Developed the EFarash application using the FAST method and PIECES analysis, showing that system integration can improve the distribution of community based textile waste products (Sany et al., 2024). Although the system achieved high user satisfaction, it did not examine non profit organizations as primary hubs for solid textile waste collection.

Research on Green Supply Chain Management (GSCM) in the context of textile waste also provides important

insights into the integration of production processes and waste reduction. Demonstrate that the integration of information systems within the supply chain can simplify material management and reduce operational costs in textile based creative industries (Herdiansyah et al., 2021). However, existing studies primarily emphasize liquid waste management and production flow optimization, rather than solid textile waste, which has distinct utilization characteristics and requires visual traceability as well as fabric type based categorization.

From a material sustainability perspective, the circular economy requires cross sectoral involvement to reintegrate textile waste into value-generating resource cycles. Nevertheless, most studies assume industrial actors as the primary drivers, while the role of nonprofit organizations as intermediary entities connecting households, small scale waste producers, and creative industry actors remains underexplored. Nonprofit organizations possess both internal and external accountability mechanisms that can strengthen public trust in donation based material collection systems (Assoba & Uzliawati, 2023). At the grassroots level, the major challenge in textile waste utilization lies not only in the absence of viable business models, but also in the lack of information systems that enable nonprofit organizations to establish program legitimacy. Putri and Widiawati (2020) report that small scale producers tend to sell textile waste rather than process it internally due to inadequate documentation and recording systems. This documentation gap constrains the development of community based circular economy initiatives, as material flows remain quantitatively invisible,

making it difficult to evaluate social and environmental impacts.

At this point, it becomes evident that integrating circular economy principles with information systems can lead to a more structured textile waste management model. However, previous studies have not explicitly positioned nonprofit organizations as central hubs within material flow networks. This gap is significant, as nonprofit organizations often function as convergence points between donor communities, waste processing actors, and markets for recycled products. Without systems that support transparency and accountability, material flows are prone to fragmentation and their contributions become difficult to measure.

Information system approaches to waste management have been explored through GSCM based application prototypes. Nevertheless, such systems are predominantly producer oriented and designed for linear supply chains, offering limited support for community based donation mechanisms. The differing characteristics of paid versus donation based material flows necessitate distinct system design logic, particularly in terms of accountability and social impact evaluation.

From a system development methodology standpoint, Agile Software Development is highly relevant due to the dynamic nature of user requirements in textile waste management. Suhadi, Hariyanto, and Sastra (2023) demonstrate that short development iterations enable systems to adapt more effectively to field conditions, reducing the risk of misalignment associated with long term development cycles (Suhadi et al., 2023). However, research on Agile implementation in textile waste management remains limited, as Agile studies predominantly focus on

corporate software engineering rather than relational and community based nonprofit systems.

Agile approaches also offer potential advantages for nonprofit organizations in managing rapidly changing data requirements, such as waste classification, material distribution schemes, and socio economic impact measurement. To date, however, no study has systematically examined how Agile can be effectively applied within community level textile waste collection and processing cycles, despite the relevance of iterative development for accommodating material variability and processing capacity constraints.

Comparative analysis of prior studies reveals a common pattern: information systems for textile waste management tend to emphasize technical dimensions such as material inventory and supply chain integration, while giving insufficient attention to legitimacy, transparency, and program documentation elements that are fundamental to nonprofit sustainability. Moreover, nonprofit literature has yet to integrate accountability requirements with material flow documentation, resulting in underexplored opportunities for strengthening circular economy initiatives through community participation.

Furthermore, most previous research frames the circular economy as an industrial approach rather than a social mechanism involving material redistribution through non commercial institutions. Consequently, the contribution of nonprofit organizations to generating socio economic value from textile waste is often undocumented due to the absence of digital systems capable of capturing non financial transactions as impact data.

Another notable gap lies in the lack of systems that facilitate collaboration among local stakeholders. Although circular economy principles emphasize material circularity, textile waste flows at the community level remain fragmented, individualized, and poorly documented. This limitation hinders quantitative and qualitative assessment of utilization potential, even though such data are essential for demonstrating program contributions to waste reduction and community based creative industry income generation.

Based on this literature review, it is evident that while prior research has achieved significant progress at the industrial and application levels of circular economy implementation, it has not adequately addressed the integration gap between information systems and nonprofit organizations as drivers of community based textile waste circularity. Accordingly, this study focuses on the development of the Textile Waste Management Information System (SILAHKAN) for nonprofit organizations using the Agile Software Development approach. The proposed system aims to document material flows as accountability data, strengthen program legitimacy, and bridge the integration gap between circular economy principles and community based organizational practices.

METHOD

In this section This study is an applied research employing a descriptive qualitative approach combined with system development research. The qualitative approach is used to understand textile waste management business processes in non profit organizations, information needs of stakeholders, and operational constraints related to transparency and accountability. The final output of the

study is a prototype of the Textile Waste Management Information System (SILAHKAN) that supports circular economy principles through reduce-reuse-recycle mechanisms in textile material flows.

The software development method employed is Agile Software Development. Agile is selected due to its lightweight, iterative, and adaptive nature, allowing continuous user involvement (administrators, volunteers, and partners) to provide feedback in each iteration. The Agile stages applied include requirements, design, development, testing, deployment, and review.

Research Object, Actors, and Scope

The research object is a non profit organization managing household textile waste based on the circular economy. Actors involved in the SILAHKAN system include donors/community members, transportation partners, volunteers/staff, administrators/managers, recycling MSME (MSME stands for Micro, Small, and Medium Enterprises) partners, and social beneficiaries (shelters/orphanages/communities). The research scope is limited to recording textile donation intake; sorting and eligibility verification; stock management; dual channel distribution (social and recycling MSMEs); documentation of handover evidence; and periodic reporting of social and environmental impacts.

Research Location and Period

The research is conducted at a non profit organization implementing textile waste collection, sorting, social distribution, and collaboration with recycling MSMEs. The research period is planned for October-November 2025.

Data Sources

Primary data are obtained through observation of textile waste management processes and semi structured interviews with administrators, volunteers, and partners. Secondary data are derived from scientific literature, organizational documents, and regulations/standards related to textile waste management and the circular economy.

Data Collection Techniques

Data collection techniques include: (1) direct observation to map as-is processes and identify recording vulnerabilities; (2) interviews to explore system requirements and reporting outputs; (3) documentation to collect receipt and handover evidence formats; and (4) literature review to strengthen circular economy and Agile Software Development foundations. Each researcher is expected to be able to make the most recent contribution related to the solution to the existing problems. Researchers can also use images, diagrams, and flowcharts to explain the solutions to these problems.

System Development Method: Agile Software Development

The Agile implementation in this study consists of six stages (Saputra et al., 2023).

1. Requirement Requirements Gathering

This stage aims to understand user needs for SILAHKAN through observation, interviews, and literature review, resulting in user needs and user stories. Outputs include functional and non functional requirements, initial backlog priorities, and business rules for dual distribution pathways (usable → social, non usable → MSMEs).

2. Design

The design stage produces system designs including UML modeling (use case and activity diagrams), conceptual database design, and low fidelity interface design. Emphasis is placed on material flow traceability, transaction evidence, and impact reporting.

3. Development

The development stage builds modules incrementally based on backlog priorities. Development is conducted per sprint with incremental delivery to enable early user testing and feedback.

4. Testing

Testing employs black box testing based on use case scenarios to ensure features function as intended. Testing is conducted at each iteration after module development.

5. Deployment

Deployment involves implementing the prototype in a user testing environment, including workflow demonstrations, access configuration, and operational scenario testing.

6. Review

The review stage evaluates user experience and workflow suitability. Feedback is analyzed and used to reprioritize the backlog for subsequent sprints, particularly regarding data validation and volunteer input usability.

Research Tools

Research tools include draw.io/Figma for process modeling and low fidelity UI design; Visual Studio Code and GitHub for development and version control; MySQL for database management; Trello/GitHub Projects for backlog management; and Microsoft

Word/Google Docs for research documentation.

Data Analysis Techniques

Qualitative data analysis is conducted through data reduction, data presentation, and conclusion drawing. Interview and observation results are transformed into system requirements and user stories. System requirement analysis uses use case modeling and activity flow mapping. Black box test results are analyzed to verify functional compliance, while review feedback is thematically analyzed for iteration improvement

Research Stages

Figure below illustrates the research flowchart, which summarizes the sequence of research activities from problem identification to prototype evaluation.

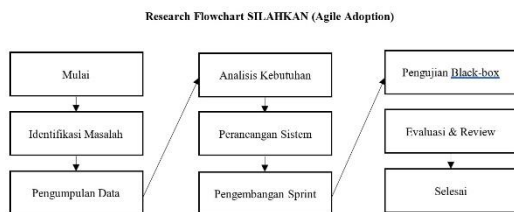


Fig. 1 Research Flowchart SILAHKAN

The iterative Agile cycle employed in this study is illustrated in figure below

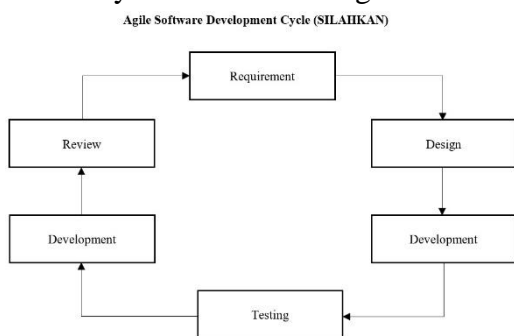


Fig. 2 Stages of Agile Software Development in This Research System Requirements Specification

Table below summarizes the functional and non-functional

requirements of the SILAHKAN system as the basis for prototype design and development.

Table1. The functional and non-functional requirements of the SILAHKAN

Jenis Kebutuhan	Butir Kebutuhan	Deskripsi Singkat
Fungsional	Manajemen Donasi	Mencatat donasi kain (antar/jemput), sumber, tanggal, dan bukti penerimaan.
Fungsional	Pemilahan & Verifikasi	Klasifikasi kain (layak/tidak) dan penetapan jalur pemanfaatan.
Fungsional	Stok & Lokasi	Stok per kategori/lokasi dan histori pergerakan item.
Fungsional	Distribusi Sosial	Penyaluran kain layak pakai + bukti serah-terima ke penerima manfaat.
Fungsional	Distribusi UMKM	Penyaluran kain tidak layak pakai ke mitra UMKM + spesifikasi bahan.
Fungsional	Pelaporan Dampak	Rekap periodik kain masuk/keluar/stok dan ringkasan dampak.
Non-fungsional	Keamanan & Hak Akses	Autentikasi dan role-based access (admin/relawan/mitra).
Non-fungsional	Usability	Form input sederhana dan navigasi konsisten.
Non-fungsional	Auditability	Pencatatan bukti transaksi dan log perubahan.

RESULT

This section presents the research results and discussion, structured according to the stages of Agile Software Development described in the Research Method section, ensuring that each methodological step produces evaluable outputs. The resulting system is the SILAHKAN prototype, which manages textile waste flows based on circular economy principles through two utilization channels: (1) social distribution for wearable textiles (reuse) and (2) distribution to recycling MSME partners for non wearable textiles (recycle/upcycle), accompanied by social and environmental impact reporting. In the reporting section, the researcher will explain the results of the research

obtained. Researchers can also use images, tables, and curves to explain the results of the study. These results should present the raw data or the results after applying the techniques outlined in the methods section. The results are simply results; they do not conclude. Results of the Requirements Stage

The requirements stage produced the initial system requirements and product backlog that served as the foundation for prototype design. These requirements were derived from process observations and interviews with administrators, volunteers, and MSME partners.

Table 2. Initial SILAHKAN Product Backlog (Results of the Requirements Stage)

ID	User Story	Aktor	Kriteria Sukses (Acceptance)	Prioritas	Sprint
US-01	Mencatat donasi kain beserta metode antar/jemput dan bukti penerimaan.	Admin/Relawan	Data tersimpan, bukti terunggah, status donasi dapat ditelusuri.	Tinggi	1
US-02	Memilah kain dan menetapkan status layak/tidak layak serta kategori pemanfaatan.	Relawan	Item kain terbentuk, status tercatat, stok bertambah sesuai kategori.	Tinggi	1
US-03	Mencatat distribusi sosial untuk kain layak pakai beserta bukti serah-terima.	Admin	Transaksi tersimpan, stok berkurang, bukti tersimpan.	Tinggi	2
US-04	Mencatat distribusi ke UMKM untuk kain tidak layak pakai beserta spesifikasi bahan.	Admin	Transaksi tersimpan, stok berkurang, mitra & spesifikasi tercatat.	Tinggi	2
US-05	Melihat laporan periodik kain masuk/keluar/stok dan ringkasan dampak.	Pengurus	Laporan tampil sesuai periode, dapat diekspor, konsisten dengan transaksi.	Sedang	3
US-06	Mencegah kesalahan jalur (layak pakai tidak boleh masuk UMKM).	Sistem	Sistem menolak transaksi dan menampilkan pesan validasi.	Tinggi	2

Discussion: The backlog highlights the distinctiveness of the SILAHKAN system compared to general inventory systems, particularly in its business rules for separating utilization pathways (social distribution versus MSME recycling) and in the inclusion of impact reporting as a core system feature.

Results of the Design Stage

The design stage produced the prototype architecture design, the to be operational workflow, and the user interface design, with a focus on ease of data entry for volunteers and transaction traceability.

Conceptual Architecture of the SILAHKAN Prototype

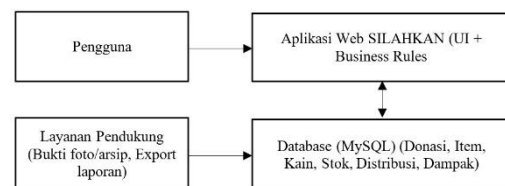


Fig. 3 Conceptual Architecture of the SILAHKAN Prototype

Circular Economy-Based SILAHKAN Operational Workflow (To-Be)

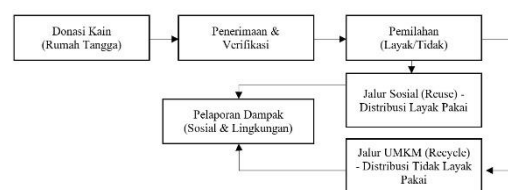


Fig. 4 SILAHKAN Operational Workflow (Dual Utilization Pathways)

Table 3. Outputs of the Design Stage and Their Alignment with User Requirements

Artefak Design	Isi/Komponen	Kebutuhan yang Dijawab	Catatan SILAHKAN
Rancangan proses (to-be)	Penerimaan → pemilahan → stok → distribusi sosial/UMKM → laporan	Traceability & efisiensi	Circular economy eksplisit melalui reuse & recycle/upcycle.
Aturan bisnis	Validasi jalur berdasarkan status layak/tidak	Mencegah salah penyaluran	Kritikal untuk akuntabilitas.
Rancangan data	Donasi, item kain, stok, distribusi sosial, distribusi UMKM, dampak	Konsistensi laporan	Mendukung audit trail.
Rancangan UI	Form sederhana + bukti transaksi + dashboard ringkas	Usability relawan	Meminimalkan error input.

Results of the Development Stage

The development stage produced a functional prototype developed incrementally across multiple sprints. Figures below present the user interface designs of the core modules resulting from the development phase.

SILAHKAN – Dashboard Admin

<p>Ringkasan</p> <ul style="list-style-type: none"> • Kain masuk/keluar per periode • Proporsi reuse vs recycle • Penerima manfaat (sosial) 	<p>Antrian</p> <ul style="list-style-type: none"> • Donasi baru • Menunggu verifikasi • Status penjemputan
<p>Stok</p> <ul style="list-style-type: none"> • Kategori & lokasi • Kondisi kain • Riwayat pergerakan 	<p>Laporan</p> <ul style="list-style-type: none"> • Export periode • Bukti transaksi • Ringkasan dampak

Fig. 5 SILAHKAN Prototype Interface Design (Admin Dashboard)

SILAHKAN – Form Pemilahan

<p>Data Donasi</p> <ul style="list-style-type: none"> • Sumber, tanggal • Berat/qty • Bukti foto 	<p>Klasifikasi</p> <ul style="list-style-type: none"> • Jenis/warna/kondisi • Layak vs tidak layak • Kategori pemanfaatan
<p>Output</p> <ul style="list-style-type: none"> • Item kain terbentuk • Stok ter-update • Label/ID item 	<p>Validasi</p> <ul style="list-style-type: none"> • Field wajib • Simpan & kunci • Log perubahan

Fig. 6 SILAHKAN Prototype Interface Design (Sorting Form)

SILAHKAN – Distribusi Sosial

<p>Penerima</p> <ul style="list-style-type: none"> • Pantil/rumah singgah • Alamat/kontak • Catatan kebutuhan 	<p>Transaksi</p> <ul style="list-style-type: none"> • Tanggal • Daftar item layak • Kuantitas
<p>Bukti</p> <ul style="list-style-type: none"> • Upload serah-terima • Tanda tangan • Lampiran 	<p>Riwayat</p> <ul style="list-style-type: none"> • Daftar penyaluran • Filter periode • Detail transaksi

Fig. 7 SILAHKAN Prototype Interface Design (Social Distribution Module)

SILAHKAN – Distribusi UMKM

<p>Mitra UMKM</p> <ul style="list-style-type: none"> • Profil & kapasitas • Jenis produk • Komitmen hijau 	<p>Transaksi</p> <ul style="list-style-type: none"> • Tanggal • Daftar item tidak layak • Spesifikasi bahan
<p>Aturan</p> <ul style="list-style-type: none"> • Cegah salah jalur • Validasi status item • Catatan kualitas 	<p>Riwayat</p> <ul style="list-style-type: none"> • Distribusi per mitra • Filter periode • Rekap volume

Fig. 8 SILAHKAN Prototype Interface Design (MSME Distribution Module)

DISCUSSIONS

Table 4. Results of the SILAHKAN Prototype Development Sprints

Sprint	Fokus	Fitur Dibangun	Masalah yang Ditemukan	Perbaikan
1	Intake & pemilahan	Penerimaan donasi; pemilahan; pembentukan item kain	Field wajib sering terlewat	Validasi wajib + dropdown kategori
2	Distribusi dua jalur	Distribusi sosial & UMKM; aturan cegah salah jalur	Risiko salah pilih jalur	Rule-based validation + pesan error
3	Pelaporan &	Laporan periode; ekspor;	Format laporan	Template laporan +

transparansi	rekap dampak dasar	perlu ringkas	filter periode
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Results of the Testing Stage

Testing was conducted using black box testing based on use case scenarios. The results indicate that all core functions operate as required and that the business rules for separating utilization pathways are successfully enforced.

Table 5. Black-Box Testing Results of the SILAHKAN Prototype

TC	Skenario	Input Uji	Output Diharapkan	Hasil	Status
TC-01	Login per peran	Akun valid (admin/relawan)	Masuk & menu sesuai peran	Sesuai	Lulus
TC-02	Tambah donasi	Data lengkap + foto bukti	Donasi tersimpan & bukti tampil	Sesuai	Lulus
TC-03	Tambah donasi invalid	Field wajib kosong	Ditolak + pesan validasi	Sesuai	Lulus
TC-04	Pemilahan	Set layak pakai	Item terbentuk + stok layak bertambah	Sesuai	Lulus
TC-05	Distribusi sosial	Item layak pakai	Transaksi tersimpan + stok berkurang + bukti	Sesuai	Lulus
TC-06	Distribusi UMKM	Item tidak layak	Transaksi tersimpan + stok berkurang + mitra tercatat	Sesuai	Lulus
TC-07	Cegah salah jalur	Item layak → UMKM	Ditolak + pesan aturan bisnis	Sesuai	Lulus
TC-08	Laporan periode	Rentang tanggal	Rekap masuk/keluar/stok + dampak dasar	Sesuai	Lulus

Results of the Deployment and Review Stage

During the deployment stage, the prototype was piloted within the organization’s operational scenario. User feedback emphasized the need for concise input forms, clear validation mechanisms, and reports that are easy to export for program reporting to donors and partners.

The review stage resulted in refinements to mandatory field validation, standardization of utilization categories, and the addition of impact summaries to enable the organization to transparently demonstrate program outcomes.

General Discussion, Strengths, and Distinctive Features

The distinctiveness of SILAHKAN compared to general waste management systems lies in its enforcement of utilization pathway separation through business rules (reuse for the social channel and recycle/upcycle for the MSME channel), as well as its support for nonprofit transparency through receipt and handover documentation. In addition, social and environmental impact reporting is designed as a core feature, facilitating sustainability evaluation.

Table 6. Advantages of SILAHKAN Compared to General Waste Management Systems

Aspek	Sistem Pengelolaan Limbah Umum	SILAHKAN
Objek limbah	Campuran/umum	Tekstil/kain dengan atribut

		kondisi & kelayakan
Model pemanfaatan	Cenderung satu jalur	Dua jalur: sosial (reuse) & UMKM (recycle/upcycle)
Aturan bisnis	Minimal	Validasi jalur untuk mencegah salah penyaluran
Akuntabilitas	Laporan operasional	Bukti transaksi + pelaporan dampak sosial-lingkungan

Limitations

The limitations of this study include the absence of real time logistics tracking integration and the lack of environmental impact calculations based on standardized emission factors. Future development may incorporate API integration with transportation partners, QR codebased labeling for textile items, and more detailed impact analytics.

CONCLUSION

This study successfully designed and developed the Textile Waste Management Information System (SILAHKAN) for a circular economy based nonprofit organization using the Agile Software Development method. The application of Agile enabled an iterative and adaptive development process, allowing user requirements to be captured more accurately through the direct involvement of organizational administrators and volunteers at each development stage.

The results indicate that the SILAHKAN system effectively supports structured textile waste management through two primary utilization pathways: social distribution for wearable textiles and distribution to recycling MSME partners for non-wearable textiles. This separation of utilization pathways enables the

practical and well documented implementation of reuse and recycle/upcycle principles within the circular economy framework.

Based on functional testing using black box testing, all core system features operate in accordance with the defined requirements and business rules. The system functions not only as an operational recording tool but also enhances nonprofit transparency and accountability through the documentation of receipt evidence, distribution records, and periodic social and environmental impact reporting.

Therefore, SILAHKAN can be concluded as a relevant and applicable information system solution for nonprofit organizations in managing textile waste based on circular economy principles, while also contributing to the development of information systems oriented toward sustainability and social impact. conclusion contains a summary of what is learned from the results obtained, what needs to be improved in further study. Other common features of the conclusions are the benefits and applications of the research, limitation, and recommendations based on the results obtained.

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