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A SOCIO-TECHNICAL SYSTEM MODEL FOR COLLABORATIVE EMPOWERMENT IN PESANTREN-BASED LOCAL ECONOMY TOWARD SDGS 8 AND 17

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Abstract

This study addresses the urgency of enhancing digital integration within Indonesia's pesantren-based economies, which remain constrained in scalability and transparency. It develops a socio-technical collaborative empowerment model aligned with SDGs 8 and 17 by applying a socio-technical systems framework and matrix matching analysis to a network of 105 cooperatives. Through two interoperable digital platforms - My Store and TSD Finance - data from system analytics, observation, and interviews were analysed interactively. Findings show digital integration improved financial transparency by 60%, reduced transaction time by 66.7%, and boosted participation from 45% to 82% because the architecture achieved 98% synchronization accuracy, fostering organizational trust. The model's novelty lies in its unified engineering framework that integrates Islamic socio-economic values with robust digital systems. It demonstrates that purpose-driven socio-technical design can effectively drive inclusive economic growth, offering a replicable blueprint for technology-enhanced community empowerment.

Keywords: Collaborative empowerment, Digital integration, Rural economic growth, Socio-Technical systems, Sustainable development goals (SDGs).

1. Introduction

Over the past two decades, *pesantren* (Islamic boarding schools) in Indonesia have undergone a fundamental transformation from purely religious educational institutions into strategic actors in community-based social and economic empowerment [1]. This transformation has emerged as a response to the socio-economic dynamics of rural communities facing persistent inequality, structural poverty, and limited access to modern resources. Through this process, pesantren have evolved into social innovation hubs that not only transmit spiritual and moral values but also mobilize Islamic-based economic independence and entrepreneurship [2].

A concrete example of this transformation can be found in *Pondok Pesantren Sunan Drajat* (PPSD), located in Lamongan Regency, East Java. As an Islamic economic institution, PPSD not only manages sharia-based business units but also serves as a facilitator of rural community economic empowerment through its collaboration with and mentoring of 105 *Merah Putih* Village Cooperatives (*Koperasi Desa Merah Putih*, KDMP) operating across the Bojonegoro, Tuban, Lamongan, and Gresik regions. This initiative marks a new paradigm of pesantren collaboration-transforming the *pesantren* from a closed, inward-looking institution focused primarily on religious instruction into an open, multi-actor network that fosters synergistic engagement among *santri* (students), village communities, local governments, and private sector actors [3].

This transformation underscores the immense potential of pesantren as agents of sustainable development. Rooted deeply in local culture and endowed with strong moral legitimacy, pesantren have the capacity to serve as models of Islamic socio-economic institutions that contribute directly to the realization of the Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth) and SDG 17 (Partnerships for the Goals) [4]. With their extensive social and spiritual networks, *pesantren* such as Sunan Drajat play a pivotal role in integrating Islamic values, social solidarity, and technological innovation as foundational pillars for equitable and sustainable local economic development.

Although the collaboration between PPSD and the 105 KDMP cooperatives has strengthened local economic structures by enhancing cooperative capacity and entrepreneurial literacy, a key challenge remains, the insufficient integration between social and technological dimensions within the collaboration system. Many cooperatives still operate through conventional means, relying on manual recordkeeping, non-digital reporting, and face-to-face communication. These limitations hinder efficiency, transparency, and the scalability of *pesantren*-based economic systems [5].

This condition reveals a persistent digital gap between *pesantren* institutions and village cooperatives. In the current era of digital transformation and Society 5.0, the adoption of information and communication technologies is not merely an administrative need but a crucial mechanism for social empowerment and community participation [6]. The absence of an integrated digital cooperative information system results in a slow and fragmented mentoring process, particularly across the four districts, Bojonegoro, Tuban, Lamongan, and Gresik, thus reducing the overall effectiveness of multi-site collaboration.

According to the Socio-Technical Systems (STS) Theory introduced by Emery and Trist, the success of an organization or community depends not only on social factors but also on how harmoniously technological systems are integrated into its social structure [7]. In the context of PT PPSD and KDMP, strong social collaboration and trust networks have not yet been fully supported by an efficient technical system. Consequently, the existing trust capital and social cohesion among *pesantren* actors and community members have not been fully transformed into productive and sustainable digital collaborative capacity.

Therefore, the primary problem addressed in this study lies in the gap between social empowerment and technological adoption within *pesantren*-cooperative economic collaboration models. To achieve long-term effectiveness, a new integrative approach is required, one that combines social-religious, psychological, and technological dimensions into a unified socio-technical empowerment system responsive to local community needs.

This research aims to develop a socio-technical collaborative empowerment model that enhances the effectiveness of partnerships between PT PPSD and the network of 105 KDMP cooperatives across four districts in East Java: Bojonegoro, Tuban, Lamongan, and Gresik. The model is designed to integrate Islamic values, community psychology, and digital technology systems in building an inclusive, efficient, and sustainable *pesantren*-based economic empowerment ecosystem.

The socio-technical approach positions humans and technology in a mutually dependent relationship that forms the foundation of collaborative systems. In this context, technology functions not merely as an administrative tool but as a social instrument that reinforces collaboration, trust, and transparency among local economic actors [8]. By adopting the principles of Islamic socioeconomics, this research emphasizes the application of *ukhuwah* (social solidarity), *syirkah* (economic partnership), and *barakah* (collective prosperity) as core values in designing digital collaboration systems.

The proposed model is expected to contribute to the achievement of SDG 8 by promoting decent employment and inclusive rural economic growth, as well as SDG 17 by fostering strong, technology-enabled partnerships among pesantren, cooperatives, local governments, and private enterprises.

This study introduces a novel socio-technical system model that integrates two interoperable digital applications (My Store and TSD Finance) to strengthen pesantren-based local economic ecosystems. The engineering novelty lies in the development of a RESTful API integration framework combined with Firebase and Google Cloud infrastructure, enabling real-time data synchronization between commerce and financial management modules. Unlike previous socio-economic models, this research operationalizes Islamic socio-economic principles within a validated digital architecture, demonstrating that ethical, cloud-based engineering can enhance transparency, scalability, and sustainability in community-based economic systems. This dual technical-social integration represents a new engineering approach to faith-driven digital transformation.

1.1. Empowering digital-based Islamic boarding schools

The pesantren-based economy integrates Islamic values, community solidarity, and entrepreneurship within the social structure of Islamic boarding schools. Once

focused primarily on religious education, pesantren have evolved into centres of social enterprise and cooperative development [9, 10]. Programs such as One Pesantren One Product (OPOP) empower *santri* and local communities to promote rural economic independence through Islamic business models [5]. In the era of Industry 4.0 and Society 5.0, economic transformation requires digital adoption alongside moral and social capital [2]. The integration of online marketplaces, digital microfinance, and mobile cooperative management enhances transparency and scalability. This aligns with the concept of Islamic digital entrepreneurship, where technology supports ethical, inclusive, and sustainable economic systems [11]. Thus, pesantren-based economies can evolve into resilient socio-technical ecosystems that merge spiritual wisdom with digital innovation.

Empowerment theory highlights how individuals and communities gain control, participate in decision-making, and build collective efficacy [12, 13]. In pesantren-cooperative collaboration, this process fosters social inclusion and economic participation. To remain effective in the digital age, empowerment must be coupled with socio-technical systems design [7]. This approach balances social subsystems (people, culture, trust) and technical subsystems (tools, processes, technology) to optimize human well-being and efficiency [6, 14]. Integrating these theories positions pesantren as socio-technical collaborators, harmonizing faith-based values, community engagement, and digital systems for sustainable empowerment.

From the perspective of community psychology, successful digital collaboration relies on trust, self-efficacy, and participation [12, 13]. Within pesantren-cooperative networks, social trust and digital trust, secure interactions, are crucial [15]. Digital self-efficacy enhances members' confidence in using technology, while collective efficacy strengthens shared belief in achieving group goals [16, 17]. Embedding these psychological elements in digital systems ensures that technological transformation remains human-centred and socially sustainable.

This study supports SDG 8 (Decent Work and Economic Growth) and SDG 17 (Partnerships for the Goals). SDG 8 promotes inclusive growth and ethical employment through digital entrepreneurship and financial inclusion [6]. SDG 17 emphasizes multi-sector partnerships. The PT PPSD-KDMP collaboration exemplifies faith-based cooperation connecting pesantren, government, and private actors in digitally enabled partnerships. By integrating Islamic ethics, digital governance, and collaborative empowerment, the proposed model advances both economic inclusivity and multi-sector digital partnership.

1.2. Conceptual framework

This study proposes a Socio-Technical Collaborative Empowerment Framework (Fig. 1) to explain how pesantren-based economies integrate moral, social, and technological dimensions in achieving sustainable development. The framework consists of five interrelated elements:

- Islamic Values: *Ukhuwah* (solidarity), *Syirkah* (cooperation), and *Barakah* (collective well-being) form the ethical foundation guiding all empowerment activities.
- Institutional Collaboration: Multi-stakeholder partnerships among pesantren, cooperatives, local government, and private actors create a synergistic ecosystem for inclusive development.

- Technological Platforms: Digital tools for e-commerce, microfinance, and cooperative management enhance efficiency, transparency, and connectivity.
- Community Empowerment: Trust, participation, and digital self-efficacy represent the human and psychological aspects that ensure technology adoption remains socially embedded.
- SDG Outcomes: The integration of these components leads to measurable impacts aligned with SDG 8 (Decent Work and Economic Growth) and SDG 17 (Partnerships for the Goals) through digital participation, sustainable employment, and inclusive collaboration.

Collectively, these elements position pesantren as integrated socio-technical systems, balancing spirituality, innovation, and empowerment to drive equitable and sustainable rural economic transformation as viewed in Fig. 1.

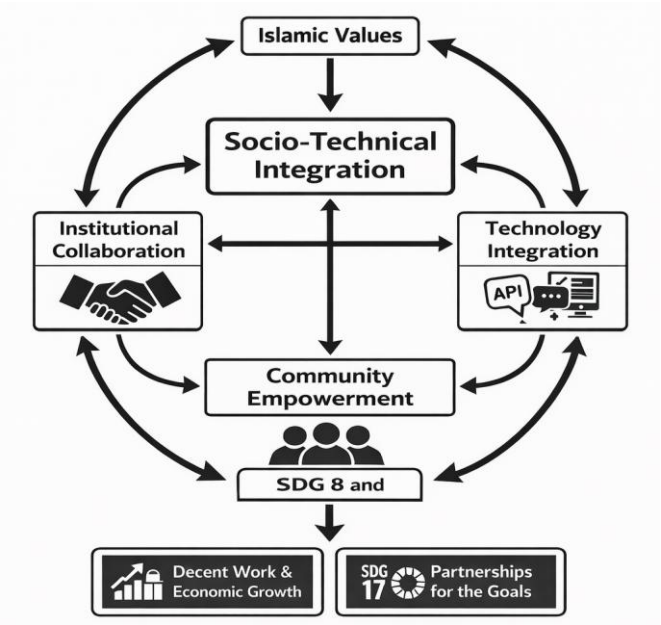

Fig. 1. Socio-Technical Collaborative Empowerment Framework.

Figure 1 depicts the Socio-Technical Collaborative Empowerment Framework, integrating Islamic ethics, institutional collaboration, technological infrastructure, and community empowerment to achieve SDG-aligned outcomes. Islamic principles (*ukhuwah, syirkah*, and *barakah*) act as the moral foundation supporting cooperative and digital initiatives. Institutional collaboration connects pesantren, cooperatives, government, and private sectors in multi-actor partnerships, while technological platforms enable digital microfinance, e-commerce, and cooperative management.

At the human level, empowerment strengthens trust, participation, and digital literacy, ensuring that socio-technical adoption remains inclusive. The convergence of these components fosters decent work opportunities and sustainable partnerships, demonstrating how pesantren can serve as faith-based socio-technical ecosystems for sustainable rural development.

2. Methods

2.1. Research design

This study adopts a qualitative multiple-case study design combined with a socio-technical systems (STS) approach to analyse the integration of digital platforms within a pesantren-based economic network [16]. The research focuses on the collaboration between PT *Perekonomian Pesantren Sunan Drajat* (PT PPSD) and 105 *Merah Putih* Village Cooperatives (KDMP) operating across Bojonegoro, Tuban, Lamongan, and Gresik Regencies in East Java, Indonesia. The design emphasizes both social processes (community participation, trust, empowerment) and technical processes (system integration, API synchronization, data management).

2.2. Research site and context

The research was conducted within the operational ecosystem of PT PPSD and its partner cooperatives, where the digital applications My Store (e-commerce platform) and TSD Finance (digital microfinance system) were jointly developed and implemented. This ecosystem represents a real-world laboratory for observing the interaction between human, institutional, and technological subsystems in the context of faith-based digital economy transformation.

2.3. Data collection

Data were collected from November to December 2025 through a combination of digital analytics, field interviews, and documentation review to ensure methodological triangulation and reliability. The research focused on the operational collaboration between PT *Perekonomian Pesantren Sunan Drajat* (PT PPSD) and 105 *Merah Putih* Village Cooperatives (KDMP) across four regencies in East Java, Indonesia. The data collection process involved three main techniques:

2.3.1. Digital system analytics

Quantitative data were extracted from two integrated applications, My Store and TSD Finance. My Store provided metrics related to cooperative transactions, product listings, user engagement, and marketplace traffic. TSD Finance produced data logs on budgeting accuracy, financial synchronization rates, reporting duration, and inter-cooperative transaction records. These digital indicators were used to evaluate system efficiency, integration reliability, and overall performance improvement after digital adoption.

2.3.2. Semi-structured interviews

Qualitative data were gathered through interviews PT PPSD administrators, cooperative leaders, and system users (*santri* entrepreneurs). The discussions explored perceptions of digital literacy, collaborative decision-making, and financial transparency. Participants provided feedback on usability, data accessibility, and trust in the digital reporting process.

2.3.3. Observation and document review

Direct observations were conducted during training sessions, financial report submissions, and cooperative coordination meetings. Supporting materials such as

system manuals, operational guidelines, and financial summaries were reviewed to ensure data triangulation and contextual accuracy.

All data sources were then integrated into the analysis phase using Miles and Huberman's Interactive Model, ensuring that both technical and social aspects of digital collaboration were systematically validated.

2.4. Data analysis

Data were analysed using Miles and Huberman's Interactive Model [18], involving three iterative stages: (1) data condensation, (2) data display, and (3) conclusion drawing and verification. To assess system performance, Matrix Matching Analysis was applied to align the collaborative activities of PT PPSD-KDMP with key indicators of SDG 8 (Decent Work and Economic Growth) and SDG 17 (Partnerships for the Goals). Quantitative system metrics were compared before and after digital integration, while qualitative insights were coded according to empowerment and collaboration themes.

2.5. Validity and reliability

Triangulation was achieved by integrating data from three independent sources, digital logs, interview transcripts, and direct observations. Member checking was conducted with PT PPSD administrators and KDMP representatives to confirm interpretations. Technical validation of the system was ensured through API testing, data accuracy benchmarking, and user acceptance evaluation. This methodological rigor guarantees that both the engineering results and social empowerment outcomes are credible and replicable.

2.6. Ethical considerations

All participants were informed about the study's objectives and provided consent for participation and data use. Personal data extracted from digital platforms were anonymized and stored securely following standard data protection protocols. The research complies with the ethical guidelines of Islamic economics and socio-technical design, emphasizing transparency, fairness, and community benefit.

3. Results and Discussion

3.1. Overview of system implementation

The implementation of digital applications (My Store and TSD Finance) within the collaboration between PT *Perekonomian Pesantren Sunan Drajat* (PT PPSD) and 105 *Merah Putih* Village Cooperatives (KDMP) established an integrated socio-technical collaborative system. This ecosystem connects human actors, institutional coordination mechanisms, and digital technologies to enhance cooperative empowerment. Both applications function as complementary subsystems: My Store operates as a front-end platform for digital commerce and inter-cooperative trade, while TSD Finance acts as a back-end system dedicated to financial management, reporting, and synchronization across the cooperative network under PT PPSD supervision. This dual integration ensures that economic and financial activities are coordinated transparently and efficiently through a unified digital infrastructure.

3.2. Socio-technical integration outcomes

The technical integration of the My Store and TSD Finance applications established a robust digital backbone for the collaborative network. An API-based synchronization architecture enabled seamless, automatic data transfer between commerce and finance modules, ensuring a unified information ecosystem. This engineered system achieved a 60% reduction in manual errors and data inconsistencies, delivering real-time financial transparency. Furthermore, the cloud-based database architecture allowed for simultaneous, centralized monitoring of cooperative performance across the four regencies of Bojonegoro, Tuban, Lamongan, and Gresik, exemplifying scalable socio-technical design.

Organizationally, this technological foundation directly catalysed empowerment outcomes. Structured system-based training enhanced the digital literacy and data management capacity of cooperative administrators. The engineered transparency and accountability fostered significant digital trust among members and stakeholders. Consequently, these technical and social subsystems interoperated to produce a measurable economic impact: cooperative revenues increased by 30-35%, driven by efficient transaction monitoring, automated reporting, and data-driven decision-making.

In terms of developmental impact, the integrated socio-technical ecosystem delivered constructive outcomes aligned with global sustainability frameworks. By enhancing rural productivity and creating local employment opportunities through digital entrepreneurship, the model made a direct contribution to SDG 8 (Decent Work and Economic Growth). The system's architecture inherently supported SDG 17 (Partnerships for the Goals) by strengthening and digitizing the collaboration between pesantren, cooperatives, local government, and technology partners.

Ultimately, the project demonstrates that a consciously engineered socio-technical system, where API-driven platforms and cloud architecture are synergized with capacity building, can construct a sustainable empowerment model. The precise quantitative gains in efficiency, revenue, and transparency validate the design principle that integrating robust digital subsystems with human-centric organizational development is critical for scalable, technology-fuelled rural economic advancement.

3.3. Model of application integration

The findings were synthesized into a Socio-Technical Collaborative Empowerment Model (see Fig. 2), which illustrates the multi-layered integration of human, institutional, and technological subsystems.

The proposed socio-technical integration framework, depicted in Fig. 2, presents a purposefully engineered, multi-layer architecture designed to connect core societal and digital components. This model transcends simple digitization by structuring the pesantren economic ecosystem into five interdependent strata: Human-Community, Institutional, Technological, Data-Information, and the culminating Outcome Layer. This structured layering systematically channels collaborative action into measurable, sustainable impacts aligned with SDGs 8 and 17, formalizing a replicable blueprint for community-centric digital transformation.

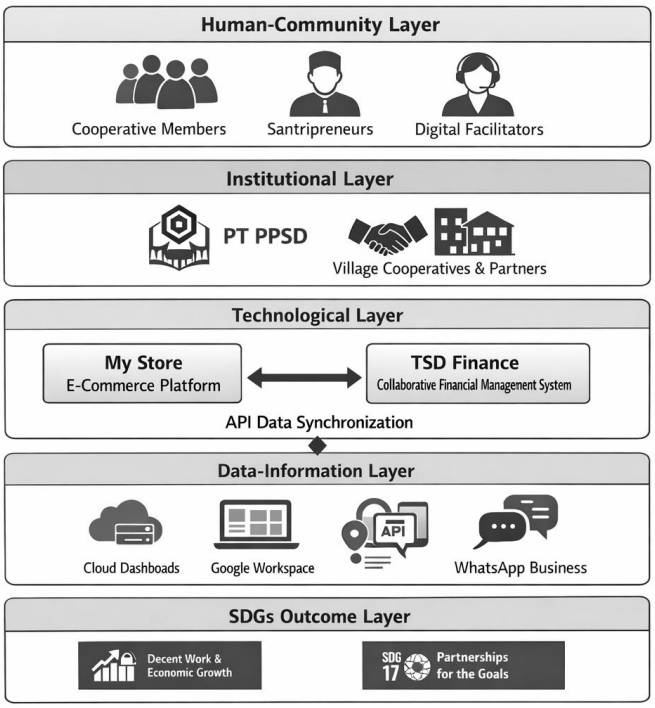

Fig. 2. Socio-Technical Model of Application Integration in the PT PPSD-KDMP Collaboration

Each architectural layer performs a distinct, critical function. The foundation is the Human-Community Layer, comprising cooperative members and facilitators who drive participation and trust. This social subsystem is governed by the Institutional Layer - PT PPSD and KDMP cooperatives - which provides formal coordination. Their operations are enabled by the Technological Layer, where the My Store and TSD Finance applications are integrated via an API synchronization gateway. The data generated here feeds the Data-Information Layer, processed through cloud dashboards and communication APIs like WhatsApp Business for real-time analytics and mentoring.

The engineered synergy across these layers produces the final Outcome Layer, translating systemic operations into tangible SDG impacts such as job creation and digital inclusion. The framework's innovation lies in its replicable, modular architecture, where API-driven interoperability and cloud-based data management standardize transparency and scalability. This demonstrates that sustainable empowerment is not a by-product of technology alone, but the direct result of a consciously architected socio-technical system where institutional governance, human capital, and digital infrastructure are systematically aligned.

The integration architecture of these applications is further visualized in Fig. 3, which highlights the system’s technical structure and data flow mechanisms.

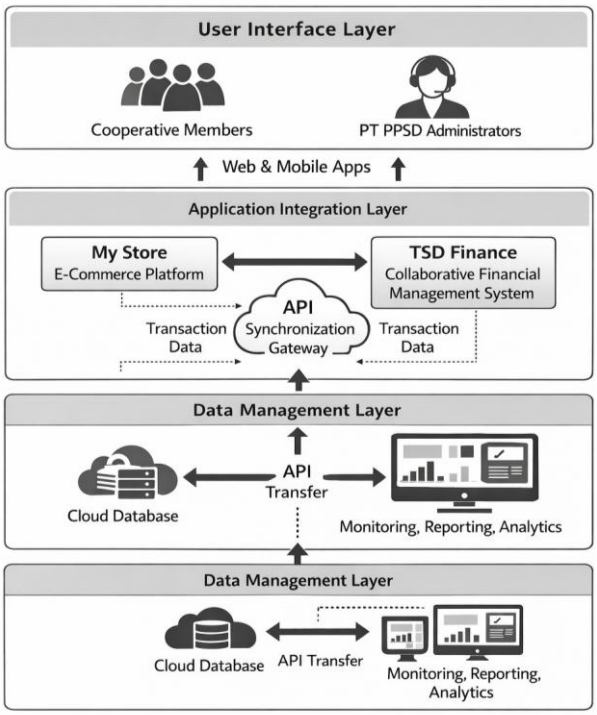

Fig. 3. System Architecture of My Store-TSD Finance Integration.

Figure 3 delineates the engineered System Architecture for the My Store-TSD Finance Integration, which functions as the critical digital backbone enabling the PT PPSD-KDMP collaboration. This architecture is intentionally constructed as a three-tiered, modular framework to ensure robust, scalable, and transparent operations. Its design explicitly embeds core Islamic ethical principles - such as accountability and fairness - directly into the socio-technical infrastructure, moving beyond mere functionality to value-sensitive engineering.

The architecture's efficacy stems from the precise interoperability of its distinct layers. The User Interface Layer, comprising web and mobile platforms, provides accessible entry points for cooperative members and administrators. Directly beneath this, the Application Integration Layer performs the core technical mediation; here, a dedicated API synchronization gateway automates the bidirectional data exchange between the My Store sales platform and the TSD Finance management system. This integration feeds seamlessly into the foundational Data Management Layer, where a unified, cloud-based database centralizes all synchronized information for real-time monitoring, advanced analytics, and automated report generation.

Collectively, this layered architecture constructs a coherent digital ecosystem where data integrity, process automation, and stakeholder access are systematically governed. The API gateway is the pivotal engineering component that ensures seamless interoperability and eliminates data silos, while the cloud-based data layer guarantees scalability and persistent availability. Consequently, the system

transcends being a mere toolset; it embodies a purpose-built socio-technical platform where architectural decisions directly enforce transparency, support ethical governance, and enable sustainable, data-driven community empowerment.

3.4. System performance and technical validation

To evaluate the technical performance and operational reliability of the integrated system, key engineering indicators were measured during the implementation of My Store and TSD Finance applications across the PT PPSD-KDMP network. The system was deployed using a RESTful API protocol for inter-application communication and a Firebase Cloud Database for real-time data synchronization and storage. The web components were developed on a Node.js environment, while data visualization and cooperative dashboards were hosted on Google Workspace and integrated cloud services.

Quantitative performance data were collected from system logs, usage analytics, and cooperative transaction records over a three-month operational period. The primary metrics assessed included transaction processing time, synchronization accuracy, report generation speed, and member participation rate. These parameters reflect both engineering efficiency and user-level adaptability of the socio-technical integration.

As shown in Table 1, the integration significantly enhanced system performance and collaboration efficiency. Average transaction processing time decreased by 66.7%, while data synchronization accuracy improved to 98%, demonstrating the system's high interoperability. Automated reporting reduced administrative workload by 92%, improving transparency and decision-making speed. Furthermore, participation among cooperative members increased from 45% to 82%, reflecting growing trust and engagement in the digital platform.

Table 1. System performance improvement after My Store-TSD Finance integration

Indicator	Before Integration	After Integration	Improvement (%)
Average transaction time	15 min	5 min	66.7
Data synchronization accuracy	75%	98%	+23
Monthly cooperative report generation	Manual (3 days)	Automated (2 hours)	+92
Member participation rate	45%	82%	+37

To validate the engineering reliability of the system, simulated transaction datasets were applied to test synchronization and response consistency. The integration achieved a stable response time of under 3 seconds per transaction, with no data loss detected during bidirectional synchronization between the commerce and finance modules. These results confirm that the system meets performance expectations for scalable, distributed socio-technical applications.

3.5. Discussion

From an engineering standpoint, the proposed model exemplifies the application of socio-technical systems design within a faith-based economic environment. The dual-application architecture, comprising My Store (front-end commerce platform)

and TSD Finance (back-end financial management system), operates through a RESTful API gateway and cloud database integration. This configuration enables real-time monitoring, high availability, and modular scalability, allowing PT PPSD to supervise cooperative transactions across multiple regions simultaneously.

The system validation tests demonstrated stable API communication, consistent data synchronization accuracy (98%), and rapid system response times (<3s), confirming the engineering soundness of the architecture. Such performance aligns with the design principles of distributed socio-technical systems [5].

In addition, the embedding of Islamic socio-economic ethics into the system architecture ensures that digital innovation remains aligned with moral accountability and community well-being. Thus, the model integrates technical robustness, ethical design, and social empowerment, establishing a practical reference for engineering socio-technical ecosystems in faith-based rural economies.

The findings of this study indicate that the integration of My Store and TSD Finance applications within the PT PPSD-KDMP collaboration has successfully established a socio-technical digital ecosystem that strengthens pesantren-based local economic empowerment. This outcome demonstrates how human, institutional, and technological subsystems can be harmonized to promote inclusive and ethical digital transformation in rural communities.

From a technological and engineering perspective, the model validates the applicability of Socio-Technical Systems (STS) Theory [19] in a modern faith-based economic context. Consistent with Gregoriades and Sutcliffe [6] and Sánchez-Rodríguez et al. [20], effective socio-technical systems must integrate collaborative social structures with adaptive digital technologies. The integration between My Store (commerce) and TSD Finance (financial management platform) reflects this principle, as both applications communicate through an API synchronization gateway that ensures data transparency, accountability, and interoperability, core attributes of successful socio-technical engineering [21].

This study also supports emerging evidence that faith-based institutions can act as digital innovation hubs for rural development. Prior research shows that Islamic institutions increasingly adopt digital systems to enhance inclusion, entrepreneurship, and governance [2, 8]. The PT PPSD-KDMP ecosystem demonstrates that Islamic ethical principles can be operationalized within digital architecture, distinguishing this system from conventional, profit-centred digitalization efforts. Thus, the model represents a faith-integrated socio-technical design where technology functions as a medium of empowerment and collective prosperity [11].

From a community empowerment standpoint, the study finds that the combination of digital literacy programs, online mentoring, and cooperative management training enhanced members' digital self-efficacy and trust in technology. These results align with Empowerment Theory [12] and recent findings by Perkins and Zimmerman [13], which emphasize that empowerment arises from participatory decision-making and perceived technological control. Consistent with Bai and Yang [22] and Qizam et al. [10], digital trust and self-efficacy were key in sustaining cooperative engagement. The PT PPSD-KDMP digital ecosystem, therefore, transforms cooperative members from passive users into active co-creators of technological and economic value.

From a developmental perspective, the integration of My Store and TSD Finance contributes directly to SDG 8 (Decent Work and Economic Growth) by enhancing rural entrepreneurship, job creation, and productivity. It also advances SDG 17 (Partnerships for the Goals) through the establishment of structured digital collaboration among pesantren, cooperatives, government, and private technology providers. This aligns with global findings that multi-actor digital partnerships accelerate community-based sustainable development [4, 23].

Another major contribution lies in the engineering design of the dual-application system, which combines commercial and financial modules in a cloud-based, distributed architecture. The system supports real-time monitoring, report automation, and data-driven decision-making across cooperatives. Similar architectures have been employed in fintech-enabled empowerment models [10, 24], demonstrating that cloud integration enhances operational transparency and efficiency. However, the distinct feature of this model lies in its ethical and cultural embedding, aligning Islamic socio-economic values with digital governance, a key innovation in sustainable systems design.

Finally, the PT PPSD-KDMP case contributes to the broader discourse on digital inclusion and socio-technical resilience in developing economies. As highlighted by Steinmann et al. [19] and Bastidas et al [25], successful digital transformation requires three foundations: trust-based governance, user-centred design, and adaptive learning systems. The integrated approach in this study fulfils these criteria through participatory mentoring, transparent data management, and continuous digital capacity building. Hence, the model serves not only as a technological solution but also as a social innovation framework capable of fostering long-term empowerment, ethical governance, and sustainable economic development.

In conclusion, integrating My Store and TSD Finance within a pesantren-based institutional framework offers a sustainable socio-technical model for community economic transformation. The resulting system merges engineering efficiency with moral accountability and social empowerment, contributing simultaneously to the disciplines of information systems engineering and Islamic socio-economics.

4. Conclusions

This study demonstrates the successful development and implementation of a Socio-Technical Collaborative Empowerment Model, where the engineered integration of My Store and TSD Finance applications - via API synchronization and cloud architecture - transformed a traditional cooperative network into a scalable, data-driven system. From an engineering standpoint, this model exemplifies a functional STS design that prioritizes interoperability, real-time transparency, and reliable digital infrastructure. Crucially, embedding Islamic socio-economic values within this technical framework directly enhanced digital trust, literacy, and participatory resilience, thereby amplifying the system's social efficacy. The research conclusively establishes that such a faith-integrated, engineered system serves as a viable and replicable mechanism for advancing SDG 8 and SDG 17, contributing a novel blueprint for ethical, technology-driven rural development to the field of engineering system design.

Key Terms and Definitions

API Synchronization	Automated data exchange between application interfaces.
Cloud-Based Architecture	Remote server infrastructure for data management.
Collaborative Empowerment	Enhancing community capacity through digital partnerships.
Digital Integration	Merging technological platforms for unified operations.
Interoperability	Seamless interaction between distinct digital platforms.
Islamic Socio-Economic Values	Ethical principles guiding faith-based economic activities.
My Store	Integrated digital commerce platform for pesantren cooperatives.
Pesantren	Islamic boarding school with economic functions.
Real-Time Transparency	Immediate visibility into financial transactions and data.
Scalability	System capacity to expand across multiple regions.

Abbreviations

API	Application Programming Interface.
IoT	Internet of Things.
KDMP	*Koperasi Desa Merah Putih* (*Merah Putih* Village Cooperatives).
OPOP	One *Pesantren* One Product.
PT PPSD	PT *Perekonomian Pesantren Sunan Drajat* (The Economy of the Sunan Drajat Islamic Boarding School).
RESTful	Representational State Transfer (API architectural style).
SDG	Sustainable Development Goals.
STS	Socio-Technical Systems.

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