JTOS Journal of Tourism Sustainability
Available online at: https://jtos.polban.ac.id/index.php/jtospolban
Journal of Tourism Sustainability
Volume 6 No 1, 2026: 31-42
DOI: 10.35313/jtospolban.v6i1.203

Communal-Digital Model for Housekeeping Efficiency: A Participatory Action Research in a Resource-Constrained Frontier Region

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Abstract

The persistent failure of standardized digital management platforms to resolve operational rifts in frontier tourism destinations stems from a fundamental misalignment between technocentric design and regional infrastructural fragilities. This study evaluates a Communal-Digital Model designed to bridge these gaps by anchoring frugal digital tools within indigenous collectivist ethics. Employing a ten-week Participatory Action Research design at a mid-scale hotel in Indonesia, the research involved 15 housekeeping personnel using messaging platforms and offline spreadsheets analyzed via reflexive thematic analysis and quantitative performance metrics. Implementation resulted in a 44.4% reduction in room turnaround duration and an 80% decrease in inventory auditing discrepancies, while autonomous staff engagement increased from 30% to 85%. These findings validate the conceptual framework of digital communalism, proving that traditional social capital drives technological transformation in non-Western, resource-scarce contexts.

Keywords: *Digital Communalism, Frugal Innovation, Participatory Action Research, Housekeeping Efficiency, Frontier Hospitality.*

To Scite This Paper:
Boiris Milyardo, Friend Zakharia, Erwin Rivaldo Leki. (2026). Communal-Digital Model for Housekeeping Efficiency: A Participatory Action Research in a Resource-Constrained Frontier Region. *Journal of Tourism Sustainability,* 6(1), 31-42. https://doi.org/10.35313/jtospolban.v6i1.203.

INTRODUCTION

The strategic positioning of hospitality enterprises hinges on housekeeping excellence, which dictates service consistency and guest satisfaction. However, in Indonesia's frontier regions, a stark dissonance exists between high-tech management aspirations and the reality of fragmented electricity and intermittent connectivity. While urban hubs move toward Industry 4.0, these peripheral zones struggle with legacy inefficiencies, high employee churn, and non-standardized workflows (Das et al., 2025a). This friction creates an operational ceiling that standard management platforms cannot break, leaving regional operators trapped in cycles of suppressed productivity (Ivanov, 2024).

Current scholarship emphasizes housekeeping as a strategic asset that stabilizes cleaning throughput and drives competitive advantage. Scholars argue that integrating lean management with smart technologies transforms housekeeping from a cost center into a value-adding capability (Chen & Jia, 2025; Das et al., 2025b). Previous models suggest that AI and robotic

assistance address labor volatility by augmenting human workers and reducing cycle times (Ivanov, 2024; Leung et al., 2025). Collectively, these studies position technology-driven standardization and data-driven optimization as the primary routes to market differentiation (Fornells Herrera et al., 2024).

This universalist logic of technological transfer often fails in marginalized territories where infrastructure remains unstable. Wholesale automation schemes encounter severe frictions when they overlook localized social capital and mutual aid practices (Das et al., 2025a). Existing frameworks frequently suffer from techno-solutionism—the flawed assumption that digital tools alone can fix systemic governance and social gaps (Campbell-Verduyn & Gstrein, 2023). This mismatch exacerbates operational rifts by ignoring indigenous social structures, such as kinship networks or collective efficacy, which govern how technology is actually assimilated (Khalil, 2025; Williams, 2023).

Therefore, this study aims to evaluate a Communal-Digital Model designed to bridge this gap by aligning frugal digital tools with indigenous collectivist ethics. Using a ten-week Participatory Action Research (PAR) design, this research tests how messaging platforms and offline spreadsheets function when anchored in local social protocols. The research was conducted at a mid-scale hotel located in an Indonesian frontier region to comply with corporate data privacy ethics. The core objective is to determine if a socio-technical synthesis can produce sustainable operational improvements in an environment characterized by severe resource scarcity.

This study offers a theoretical advancement by validating the concept of digital communalism in a non-Western, rural context. It establishes that traditional social capital drives digital transformation instead of impeding it, challenging the assumption that indigenous values are incompatible with modernization. Practically, the paper provides a replicable implementation protocol for hotel operators in frontier regions to achieve measurable efficiency gains using low-cost, intuitive interfaces. Following this introduction, the paper describes the PAR methodology, presents the resulting efficiency metrics, and concludes with a discussion on the sustainability of digital-community partnerships in peripheral tourism markets.

LITERATURE REVIEW

The Strategic Reconceptualization of Housekeeping Operations

Contemporary hospitality scholarship conceptualizes housekeeping as an integrated strategic asset rather than a back-of-house utility focused on cost containment. Evidence suggests that operational excellence in this department establishes the fundamental parameters for service consistency and competitive positioning (Fornells Herrera et al., 2024). A value-chain perspective indicates that re-evaluating housekeeping as a strategic capability allows firms to leverage it for competitive differentiation and value creation (Chen & Jia, 2025). This repositioning aligns with technology-driven approaches that link housekeeping performance to broader sustainability and efficiency agendas, effectively enhancing market positioning in saturated environments (Das et al., 2025b; Fornells Herrera et al., 2024).

The application of lean management facilitates this shift by demonstrating that improving housekeeping alongside support activities yields holistic improvements in cost efficiency and service quality (Chen & Jia, 2025). Standardizing cleaning protocols and optimizing interdepartmental communication reduces cycle times and harmonizes guest experiences across properties (Fornells Herrera et al., 2024; Kalsi et al., 2025). Furthermore, these micro-efficiencies provide a foundation for broader sustainability gains, particularly when housekeeping tasks are connected to energy, water, and waste management through computational optimization (Das et al., 2025b). Such integrated operations unlock broader cost savings, supporting strategic cost leadership within the hospitality value chain (Chen & Jia, 2025).

Operational resilience emerges as a response to labor volatility and systemic workforce shortages (Ivanov, 2024). Automation serves as a strategic enabler that can substitute or augment repetitive housekeeping tasks while reducing long-term labor cost pressures (Fornells Herrera et al., 2024; Ivanov, 2024). Managerial perspectives suggest that robotic assistance empowers personnel to focus on high-value guest interactions and care, which is central to differentiating service in labor-constrained markets (Akgün, 2024). Effective organizational design must incorporate staffing agility and ethical considerations to maintain high-quality performance through human-robot collaboration (Leung et al., 2025). By stabilizing cleaning throughput, hotels preserve guest satisfaction and repeat visitation, which determine long-term financial outcomes and competitive differentiation (B Richman et al., 2023; Begum et al., 2025).

The Digital Divide and the Failure of Techno-Solutionism

The digital divide in Indonesia's peripheral regions manifests as a series of systemic infrastructural and governance frictions that impede the adoption of Industry 4.0 automation. In the context of Indonesia's 3T territories, gaps in connectivity, energy reliability, and maintenance capacity determine the feasibility and sustainability of automated solutions. Unlike urban centers, these regions face uneven infrastructure distribution that creates an information have-less class, where participation in digital economies is restricted by physical and social deficits (Khalil, 2025; Williams, 2023). These constraints establish an environment where high-tech protocols often remain incomplete or non-functional, as the benefits of digital innovations are unevenly distributed across rural and urban spaces.

Despite these infrastructural realities, management frameworks often promote a universalist modernization paradigm characterized by techno-solutionism, where digital tools are treated as technical fixes for complex social and governance challenges (Campbell-Verduyn & Gstrein, 2023). This approach is problematic in marginalized contexts because it ignores the socio-cultural and governance dimensions required for effective integration (Marvin et al., 2023). Technocratic solutions frequently migrate to environments with uneven readiness, risking misaligned incentives and an erosion of trust in automated systems (Linares-Lanzman et al., 2025). (Campbell-Verduyn & Gstrein, 2023) argue that such digital fixes do not address root causes and may result in brittle infrastructures that fail under real-world operational pressures.

Addressing these systemic failures requires a shift toward right-sizing digital initiatives through phased, place-specific deployment strategies (Raman et al., 2024). This infrastructure-aware approach prioritizes alignment with local capacities and governance arrangements over the wholesale transfer of standardized systems. (Aditya et al., 2023) emphasize that the effectiveness of digital policy rests on aligning instruments with ground-level community needs and realities rather than technocratic imposition. By grounding digital progress in the specific organizational capacities of the frontier environment, interventions can build local capacity and infrastructure in tandem with technological initiatives, ensuring long-term operational resilience.

Frugal Innovation and Low-Threshold Digital Interfaces

Frugal innovation in developing economies emphasizes technological solutions that rely on low-cost, accessible instruments and require modest skill sets for implementation. (Raman et al., 2024) argue that context-sensitive configurations—rather than wholesale technology transfers—produce more reliable performance in peripheral markets characterized by unstable infrastructure. This approach prioritizes interface-light solutions that bypass dependence on expensive, centralized systems while delivering measurable productivity gains (Ivanov, 2024; Raman et al., 2024). By aligning digital ambitions with ground-level organizational capacities, frugal innovation establishes a viable pathway to operational resilience in resource-scarce environments.

Empirical evidence demonstrates that low-threshold digital instruments deliver efficiency gains comparable to more complex, high-capital systems when properly matched to local conditions. (Susilo, 2024) illustrates how lightweight interfaces, such as QR-based payment systems and messaging platforms, streamline transactions and reduce coordination friction with minimal infrastructure expansion. These accessible tools function as core capacity-builders, enabling small-scale operators to realize material improvements in cash-flow visibility and logistical tracking without requiring specialized technical staff. (Chourasiya & Malviya, 2025) further posit that such technologies provide significant gains when they are specifically aligned with the existing capabilities and sustainability objectives of the enterprise.

The efficacy of these digital tools depends on their complementarity with human work and their capacity to bypass steep learning curves. (Campbell-Verduyn & Gstrein, 2023) argue that simple interfaces coupled with human-centric design tend to be more robust than complex systems in the face of volatile connectivity and energy reliability. (Pambudi, 2024b) emphasizes that picking specific digital components that pair with existing processes—rather than deploying full-scale, high-cost ecosystems—minimizes adoption barriers in labor-intensive sectors. This orientation facilitates a transition toward autonomous technological engagement by ensuring that the digital transition remains grounded in the socio-cultural values and regulatory contexts of the operational milieu (Ojong, 2025; Pambudi, 2024b).

Indigenous Social Structures as Socio-Technical Catalysts

Digital communalism establishes that technological adoption in remote regions depends on the alignment of digital initiatives with localized social arrangements and governance structures. (Aditya et al., 2023) argue that digital policy effectiveness rests on the capacity to harmonize policy instruments with ground-level community needs and realities. In the Indonesian context, traditional social practices and regional diversity mediate how communities participate in digital economies, suggesting that successful adoption is a product of social legitimacy rather than technical installation (Pambudi, 2024a). This collective agency allows for a community-centered digital development where local governance and indigenous ethics serve as the architecture for technological acculturation.

Informal social hierarchies and kinship networks function as natural pedagogical environments that facilitate digital inclusion in non-urban settings. (Khalil, 2025) demonstrates that informal local arrangements interact with infrastructure deficits to dictate participation patterns among the information have-less class. In peripheral areas, connectivity and technological capability are often mediated by these social arrangements, which enable productive gains outside urban cores (Zhou & Wang, 2023). By utilizing existing community-level governance and inclusion mechanisms, organizations can ensure that the benefits of digital innovations are distributed through locally legitimate channels (Williams, 2023). This culturally grounded approach suggests that adoptions are more likely to be sustained when they leverage indigenous support networks to reduce technological hesitation.

The effectiveness of digital platforms depends on their socio-technical embeddedness, which requires reinforcing rather than displacing local social covenants. (Campbell-Verduyn & Gstrein, 2023) caution against treating technology as a technocratic fix, arguing that sustainable adoption remains impossible without attending to governance and social cohesion. Digital communalism must therefore be deliberately cultivated through co-design with community groups, ensuring that digital tools fit within ongoing social and political work. When digital initiatives are designed with local social structures in mind — incorporating collective decision-making and shared responsibility — the resulting transformation achieves higher levels of social legitimacy and durability (Aditya et al., 2023).

Theoretical Synthesis: The Communal-Digital Framework

The Communal-Digital Framework emerges from the theoretical convergence of appropriate technology doctrine and community-based digital transformation. This synthesis argues that operational gains in resource-scarce environments are dictated by the alignment of digital ambitions with ground-level infrastructure and local organizational capacities (Raman et al., 2024). Appropriate technology prioritizes the deployment of low-threshold, lightweight interfaces—such as messaging platforms and QR-based systems—which facilitate real-world productivity for small-scale operations (Danarta et al., 2024; Pambudi, 2024b). When these tools are embedded within a governance framework that emphasizes community needs and local legitimacy, they create self-renewing digital habitats that remain resilient despite infrastructural volatility (Aditya et al., 2023; Zhou & Wang, 2023). This approach challenges universalist automation schemes by positioning technological adoption as an extension of existing social covenants rather than a technocratic imposition (Campbell-Verduyn & Gstrein, 2023; Das et al., 2025a).

Building on this synthesis, this study establishes that sustainable housekeeping efficiency in frontier regions is a product of socio-digital harmonization rather than technocentric installation. While technocentric models often treat digital tools as standalone remedies for operational gaps, the Communal-Digital Framework posits that efficiency is realized through the purposeful co-formation of digital instruments and local social structures (Campbell-Verduyn & Gstrein, 2023). The strategic reconceptualization of housekeeping as an integrated strategic capability demonstrates that performance consistency depends on a data-driven foundation that is culturally and logistically right-sized (Chen & Jia, 2025; Das et al., 2025b). Consequently, the research focus establishes the premise that aligning frugal digital interfaces with indigenous collectivist ethics generates superior operational outcomes—such as reduced coordination time and enhanced inventory precision—compared to prescriptive automation transfers that overlook local social realities (Das et al., 2025a; Susilo, 2024).

METHODS

This study adopts a Participatory Action Research (PAR) design through an instrumental case study to evaluate the Communal-Digital Model within a real-world operational context. To comply with publication ethics and protect institutional privacy, the research site is pseudonymized as a mid-scale hotel located in an Indonesian frontier region characterized by significant infrastructure gaps. All participants provided informed consent, and an explicit Ethical Statement confirms that specific corporate identities and absolute operational metrics were masked to prevent Non-Disclosure Agreement (NDA) violations while preserving the region's unique cultural and infrastructural context. The PAR approach transforms conventional research paradigms by positioning hotel personnel as co-creative partners rather than passive subjects, ensuring that the resulting operational interventions remain culturally and practically relevant.

The research involved 15 housekeeping staff members selected through purposive sampling to represent a heterogeneous workforce profile, with an age spectrum of 22–45 years and educational backgrounds ranging from junior high school to bachelor's degrees. Preliminary digital competency assessments revealed that 60% of the participants were beginner smartphone users, necessitating an intervention model that prioritizes low-threshold digital instruments. The resulting Communal-Digital Framework employs a configuration of WhatsApp Business for real-time coordination, offline spreadsheets for inventory tracking, and visually-oriented instructional materials. This technological setup operates on personal mobile devices, supplemented by a shared laptop for data consolidation, to account for the restricted digital ecosystem of the frontier region.

Data collection occurred over ten weeks through three iterative cycles of planning, action, monitoring, and reflection. To ensure the validity of the reported efficiency gains, the research team conducted a formal baseline audit prior to the first PAR cycle to establish initial performance benchmarks. Quantitative metrics, including cleaning duration and inventory error rates, were gathered through structured time-motion studies performed by supervisors using standardized observation protocols equipped with descriptive notes. This multi-method strategy integrated 40 hours of participant observation, fifteen semi-structured interviews lasting 45–75 minutes, and systematic analysis of organizational documentation.

The analysis followed Braun and Clarke's (2019) six-phase reflexive thematic analysis for qualitative data, while quantitative efficiency gains were converted into relative percentages to maintain data confidentiality. Methodological rigor was maintained through data triangulation, peer debriefing with industry practitioners, and member checking during participatory reflection forums. These forums allowed participants to validate interim findings and collaboratively construct the interpretive account of the intervention's impact. By synthesizing ethnographic records with operational artifacts, the study establishes a substantive link between communal social structures and measurable digital adoption outcomes.

RESULTS AND DISCUSSION

The Digital Adoption Continuum and Cultural Acculturation

The implementation process followed a precisely delineated three-stage adoption continuum as illustrated in Figure 1. During the resistance phase (Weeks 1–2), 70% of personnel manifested substantial psychological barriers toward the digital intervention. This initial friction transitioned into an adaptation window (Weeks 3–4), which exhibited a 45% expansion in self-initiated digital engagement. The process culminated in a consolidation term (Weeks 5–10), where 85% of staff consistently employed technological solutions autonomously for operational decision-making.

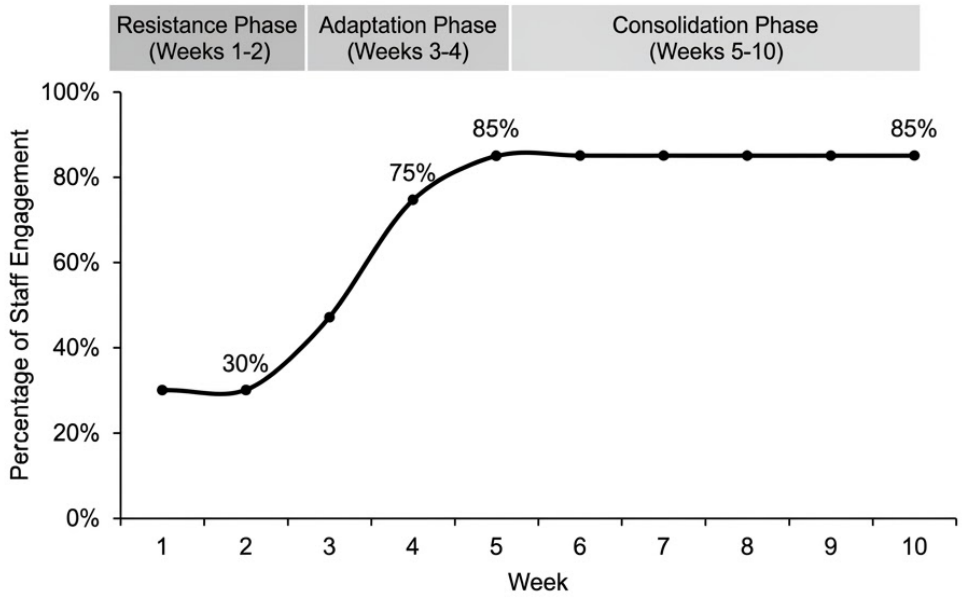

Figure 1. The 10-Week Adoption Curve
Source: Research data, 2025

Statistical assessments of these transitions align with the Technology Acceptance Model (TAM), confirming that perceptions of practical value and operational simplicity were cultivated through scaffolded peer-learning networks. This developmental trajectory suggests that

assessments of technological utility did not materialize instinctively but were rather structured through social mediation. Employee feedback indicated that the cultural institution of gotong royong functioned as the primary acculturation architecture for technological incorporation, reconfiguring preliminary skepticism into strategic benefits.

The adoption process capitalized on existing kinship structures to establish cross-generational mentoring environments. Within these pedagogical structures, digitally proficient junior personnel supported skill development among senior staff, effectively diminishing technological hesitation. This approach to culturally-grounded computing facilitated a 10-week assimilation process that augmented established indigenous paradigms and collective behavioral patterns. Consequently, the designated collaborative period proved necessary for developing autonomous local capacity and maintaining functional sustainability.

Quantifiable Operational Achievements

As presented in Table 2, all operational constructs demonstrated measurable improvements relative to the pre-intervention baseline. Cleaning time efficiency exhibited a 44.4% reduction in room turnaround duration. This performance gain indicates that the communal-digital coordination mechanism synchronized room readiness alerts with housekeeping availability. Inventory tracking accuracy showed an 80% decrease in auditing discrepancies. The integration of offline spreadsheets for logistical tracking resolved legacy inventory errors by providing immediate data validation within the housekeeping unit. Workforce stability metrics confirmed high levels of operational adherence, with 85% of personnel consistently utilizing the digital framework autonomously. This level of engagement suggests that the model effectively mitigated the psychological barriers and labor churn associated with technological adoption in marginalized regions.

Table 2. Comparative Operational Performance

Operational Metric	Baseline Status (Relative)	Post-Intervention (Relative)	Performance Variance
Room Cleaning Turnaround	100.0%	55.6%	-44.4%
Inventory Audit Discrepancies	100.0%	20.0%	-80.0%
Staff Autonomous Engagement	30.0%	85.0%	+183.3%

Source: Research data, 2025

The Socio-Digital Workflow Integration

The socio-digital workflow utilizes multimodal communication to synchronize interdepartmental activities. As presented in Figure 2, WhatsApp Business functions as the primary interface for real-time room status updates and voice-based reporting. This configuration bypasses the barriers associated with text-heavy documentation, addressing the digital competency variations identified in the study population. The integration of voice and visual elements ensures operational data accessibility regardless of technological background.

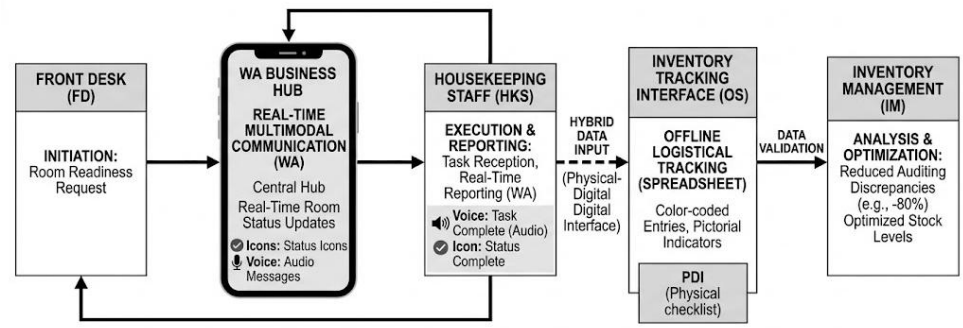

Figure 2. Information Flow Diagram (Front Desk–Housekeeping–Inventory Management).
Source: Research data, 2025

Offline logistical tracking is operationalized through color-coded spreadsheets, which maintain inventory accuracy independent of internet connectivity. These interfaces utilize chromatic coding and pictorial indicators to facilitate rapid data entry and stock auditing. By localizing data storage on shared devices, the model prevents systemic bottlenecks caused by fluctuating broadband reliability in frontier regions.

The final operational model represents a physical-digital interface where digital data entry complements traditional collective practices. The indigenous ethos of gotong royong is transposed into structured digital coordination, transforming discrete cleaning tasks into shared obligations within the messaging group. Procedural simplification via hybrid reporting—combining physical checklists with digital validation—reduced coordination friction and enhanced data precision. This synthesis ensures that technological tools reinforce established social covenants instead of displacing existing knowledge traditions.

Emergence of Self-Sustaining Communities of Practice

Collaborative knowledge construction was evidenced by staff-initiated refinements to digital templates, documenting a transition toward a digital commons. The operational platform evolved into a synergistic ecosystem that concurrently optimized workflows and reinforced social capital. These self-organizing learning ecosystems autonomously generated alternative operational methodologies during the final stages of the research cycle. As presented in Table 2, the 183.3% increase in autonomous engagement relative to the baseline confirms the establishment of these self-sustaining internal practices.

Distributed leadership emerged as junior personnel assumed informal facilitator roles within their kinship groups. This cross-generational mentoring facilitated technical skill development among senior staff and neutralized psychological barriers to adoption. The peer-learning mechanism allowed the housekeeping unit to maintain the digital framework through internal capacity without requiring external technical intervention. This pedagogical arrangement effectively utilized existing social hierarchies to ensure technological continuity.

Collective incentive outcomes demonstrated that team-based rewards strengthened indigenous distributive ethics. Mapping incentives to functional zones aligned performance management with established collectivist paradigms. This structural alignment resulted in concurrent gains in communal integrity and operational accountability, reinforcing the sustainability of the digital transition. The deployment of these incentives ensured that individual productivity remained secondary to the collective stability of the housekeeping department.

Operational Frictions and Behavioral Limitations

The implementation of the communal-digital model encountered specific operational frictions and behavioral limitations that influenced system consistency. As presented in Table 3, the burden of support emerged as a primary constraint, where junior facilitators experienced role overload by balancing technical troubleshooting for senior staff with their own cleaning quotas. This role ambiguity generated a measurable cognitive load, as these personnel functioned as informal system administrators without a corresponding reduction in their primary room-turnover targets.

Digital communication fatigue also materialized during peak occupancy periods. Staff reported notification overload from the central hub, with an average frequency of 45 alerts per device daily. This volume impacted staff focus and psychological well-being by creating a state of continuous administrative alert, which occasionally interfered with active cleaning duties. Furthermore, the digital workflow exhibited infrastructural brittleness linked to hardware constraints. Battery depletion and insufficient device memory accounted for 12% of documented operational delays, confirming that the physical durability of individual hardware in frontier regions limits system consistency.

Table 3. Observed Operational Frictions and Systemic Constraints

Constraint Category	Measurement Parameter	Observed Data Point
Role Overload (Junior Staff)	Mean peer-support time	2.5 hours/week per facilitator
Communication Fatigue	Notification frequency	45 alerts/day per staff member
Infrastructural Brittleness	Hardware-related delays	12% of total workflow interruptions
Systemic Resistance	Initial skepticism	70% of personnel (Weeks 1-2)

Source: Research data, 2025

Discussion

The persistent failure of standardized digital solutions to resolve operational rifts in frontier tourism destinations stems from a fundamental misalignment between technocentric design and regional infrastructural realities. The findings of this study establish that housekeeping efficiency in resource-scarce environments is not a product of technological sophistication, but rather of frugal communalism. Operational excellence materializes when lightweight digital instruments—specifically multimodal messaging interfaces and offline data architectures—are deliberately embedded within existing indigenous social covenants. This synthesis suggests that for marginalized hospitality operators, resilience depends on the strategic coordination of low-bandwidth tools with collective social capital, effectively bypassing the infrastructural barriers that render Industry 4.0 protocols non-functional in peripheral regions.

The observed reduction in room turnaround duration through the Communal-Digital Model challenges the prevailing assumption that high-capital automation is the sole precursor to housekeeping excellence. While (Chen & Jia, 2025) argue that integrated, cloud-based property management systems (PMS) drive value-chain differentiation, these findings indicate that such systems are often unsustainable in frontier contexts due to infrastructural brittleness. Instead, the results extend the work of (Das et al., 2025a; Susilo, 2024) by demonstrating that right-sized digital frugality produces comparable performance gains without requiring wholesale technological transfers. The mechanism driving this success is the transformation of individual housekeeping tasks into shared social obligations, leveraging the gotong royong ethos to synchronize interdepartmental data flow. By localizing coordination within familiar messaging groups, the model reduced the administrative friction that typically occurs when staff must transition between physical labor and complex digital reporting.

This transition from initial resistance to high levels of autonomous engagement further contradicts traditional technology acceptance models that prioritize individual technical ease of use as the primary adoption driver. Unlike prior models that emphasize individual cognitive perceptions, our findings suggest that in collectivist frontier regions, social legitimacy and communal endorsement take precedence. The adoption curve stabilized only after the intervention used kinship networks as pedagogical environments, with junior staff serving as informal digital facilitators. This specific social architecture neutralized the psychological barriers that often stall digital transformation in rural areas, confirming that indigenous knowledge hierarchies can accelerate rather than impede technological assimilation. The success of the model was therefore contingent on its capacity to reinforce, rather than displace, the existing social fabric of the housekeeping unit.

This research enriches Socio-Technical Systems (STS) theory by identifying communal agency as a critical boundary condition for technological assimilation in non-Western, resource-constrained environments. While foundational STS models establish the necessity of social and technical joint optimization, they largely overlook the role of indigenous social capital as the primary engine for digital durability. By proving that kinship-based mentoring and collective social protocols can substitute for formal institutional training, this study adds a cultural-distributive dimension to the theory. It establishes that in marginalized settings, the social system does not merely support the technical system but actively dictates its architecture and sustainability. This finding extends the theory's reach into the information-have-less class,

demonstrating that technological utility is governed by its socio-technical embeddedness within local knowledge traditions (Khalil, 2025).

For hotel operators in frontier regions, these findings demand a tactical shift away from high-cost, cloud-dependent software toward resilient, minimalist digital stacks. Management must prioritize formalizing messaging-based coordination hubs and offline auditing templates that mirror existing informal communication patterns. Rather than recruiting external technical consultants, operators should identify and incentivize internal digital anchors—typically younger, tech-proficient staff—to lead peer-to-peer mentoring within their respective kinship groups. Structurally, performance metrics must evolve from individual room-count targets toward collective unit throughput to avoid the burden of support and role overload identified among junior facilitators. Regional policymakers and destination management organizations (DMOs) should abandon the push for universal smart-tourism platforms in favor of supporting infrastructure-aware pilots that leverage existing community organizations for localized data governance.

CONCLUSION

The Communal-Digital Model establishes that operational efficiency in frontier hospitality destinations is governed by the successful integration of frugal technology within indigenous social covenants. This research confirms that housekeeping excellence in resource-scarce environments does not require high-capital automation; rather, it demands a socio-technical alignment that leverages existing social capital to overcome infrastructural fragility. By substituting complex management software with low-threshold messaging interfaces and kinship-based mentoring, marginalized operators achieve measurable gains in room turnaround and inventory precision. This study proves that digital communalism is a functional reality, demonstrating that when digital tools reinforce rather than displace traditional mutual-aid practices, they create resilient operational ecosystems capable of functioning independently of Industry 4.0 standards.

Limitations

This research encountered specific boundaries that define the scope of its findings. The 10-week Participatory Action Research cycle provides evidence of immediate adoption and efficiency gains but does not account for the model's long-term sustainability over a multi-year period. Furthermore, the study was conducted within the specific regulatory and cultural context of an Indonesian frontier region where the ethos of gotong royong is deeply embedded; consequently, the generalizability to regions with different social configurations remains untested. Methodologically, the reliance on relative percentage-based metrics—while necessary to protect corporate data privacy—precludes a detailed absolute financial ROI analysis. Finally, the study identified operational frictions, such as hardware-related delays and communication fatigue, but did not use longitudinal psychological assessments to quantify the long-term risk of burnout among junior digital facilitators.

Future Research

Future scholarship should address these boundaries by initiating longitudinal studies of 12 to 24 months to evaluate the durability of communal-digital partnerships and the risk of staff fatigue over time. Comparative research in other emerging markets—such as rural tourism hubs in Sub-Saharan Africa or the Andes—would determine how varying indigenous social structures influence the efficacy of frugal digital tools. Scholars are encouraged to incorporate objective financial performance metrics, such as improvements in net profit margin and hardware maintenance costs, to provide a clearer economic justification for the model. Additionally, testing

automated load-balancing protocols or formalizing the digital facilitator role within organizational charts could provide a structural solution to the role overload identified in this study. Integrating quantitative psychological scales to monitor the well-being of technical facilitators would further strengthen the sociological analysis of communal technological adoption in peripheral regions.

ACKNOWLEDGEMENT

We extend our sincere appreciation to Politeknik Negeri Kupang for its institutional support, Hotel Nusantara Dua Atambua for its research collaboration, and all community participants in the regions, whose collective contributions were essential to the completion of this study.

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