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Integrated Digital Cooperative Business Model: Artificial Intelligence-Based Aggregation and Consolidation of the Tourism-MSME Value Chain in Kuningan Regency

Muhammad Khoirul Umam*, Muhammad Asril Maulana, Abdul Robi Padri
Politeknik Siber Cerdika Internasional, Indonesia
Email: Muhammad_khoirul@polteksci.ac.id*, muhammad_asril@polteksci.ac.id, abdulrobi@polteksci.ac.id

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Value Chain Aggregation; Artificial Intelligence; Digital Cooperatives; Tourism; MSMEs.

Abstract
The digital transformation of cooperatives and micro, small, and medium enterprises (MSMEs) is essential for strengthening local economic resilience; however, fragmented supply chains continue to create stock imbalances between MSME producers and tourism businesses in Kuningan Regency. This study aimed to design and conceptually validate an artificial intelligence-supported Integrated Digital Cooperative Business Model that positioned cooperatives as aggregators and consolidators of tourism-MSME products. A qualitative descriptive single-case study approach was employed using Transdisciplinary Action Research, Living Lab, Human-Centered AI Design, Waterfall, and CRISP-DM frameworks. Data were collected through interviews with 29 stakeholders, a focus group discussion involving 10 participants, field observations, document reviews, a digital readiness survey of 45 MSME actors, expert validation by three experts, and user testing involving 15 respondents. The findings revealed fragmented transactions, manual record-keeping practices, and simultaneous overstock and stockout conditions. The proposed model integrated six platform modules, a hybrid Business Model Canvas, and rule-based recommendation mechanisms based on tourism calendars. Expert validation confirmed that 11 of 12 assessment items were valid, while users reported high levels of perceived usefulness, usability, trust, and intention to adopt the system. In conclusion, the proposed model has the potential to strengthen market access, improve transaction efficiency, and enhance collaborative value creation. However, functional prototyping, financial feasibility testing, broader validation, and gradual development of machine-learning capabilities remain necessary to support future scalability.

INTRODUCTION

The digital transformation of cooperatives and micro, small, and medium enterprises (MSMEs) has become a global strategic agenda aimed at strengthening local economic resilience amid post-pandemic supply chain disruptions. International studies have shown that the digitalization of collaborative platforms can restructure relationships among economic actors, expand market access, and reduce transaction costs within previously fragmented value chains (Dawson et al., 2024). The application of artificial intelligence (AI) in supply chain management has also become a major focus in global operations management research, particularly in demand forecasting, inventory optimization, and service personalization, enabling small business entities to adapt more effectively to market fluctuations (Pournader et al., 2021). Similarly, studies on big data analytics capabilities among MSMEs have emphasized that digital platform capabilities and collaborative networks are important determinants of

innovation and performance among small and medium-sized enterprises in various developing country contexts (Bhatti et al., 2022).

Indonesia has positioned the digitalization of cooperatives and MSMEs as one of the main pillars for strengthening economic resilience through various cross-ministerial policies that encourage collaboration between financial service institutions and small business actors (Adrian & Scholar, 2023; Subagyo et al., 2024a). The establishment of the Red and White Village/Village Cooperative (KDKMP) as an emerging policy instrument reinforces the role of cooperatives as nodes for the production and distribution of local products at the grassroots level (Effendi et al., 2025; Hamdani, 2025). Various national studies have also demonstrated that digitalization of cooperatives and MSMEs improves operational efficiency, strengthens governance, and expands marketing reach through the utilization of digital platforms, e-business systems, and computer-based information systems (Chulkamdi et al., 2025; Stuart et al., 2022; Nurlaili et al., 2024). However, most existing studies still position technology primarily as an administrative tool and have not strategically positioned cooperatives as aggregators and consolidators within cross-sectoral supply chains.

The tourism sector and MSMEs in Kuningan Regency represent two economic pillars with significant growth potential, and KDKMP Cikaso, Kramatmulya District, serves as a platform for the production and distribution of local products connecting these sectors (Nurhayati, 2025). However, initial findings from this study indicate that this potential remains constrained by fragmentation within the village economic ecosystem. Cooperative data management is still dominated by manual recording through administrative books and basic spreadsheets, promotional activities remain conventional and sporadic, and, most importantly, there is no integrated data system connecting MSME product availability with tourism demand patterns (Effendi et al., 2025; Ratnawati & Santoso, 2024). The absence of an aggregation platform results in uneven product distribution, limited MSME market access, and weakened bargaining positions among small business actors (Hamdani, 2025). This condition was empirically confirmed through field observations, which revealed that accumulated MSME products at production sites (overstock) during periods of low visitor activity occurred simultaneously with shortages of local products at tourism destinations (stockout), providing direct evidence of the value chain paradox underlying this research.

These challenges led to the following research problem formulations: (1) how the Integrated Digital Cooperative Business Model can efficiently aggregate and consolidate MSME-tourism products while strengthening stakeholder connectivity within the village economic ecosystem in Kuningan Regency; (2) why the integration of digital cooperatives, MSMEs, tourism, and AI has the potential to generate higher economic value and strengthen the collaborative ecosystem of local Kuningan products; and (3) how artificial intelligence can be operationalized within such business models to improve supply chain efficiency, demand management, and service personalization.

Scientifically, research on cooperative business models has evolved from traditional organizational forms toward modern economic entities emphasizing member participation and professional governance in responding to market dynamics (Intiar et al., 2025; Mazzarol et al., 2018; Nagovitsina & Drozdova, 2021; Pönkä, 2019; Umam, 2025; Umam et al., 2025). Cooperatives have also been recognized as mechanisms for risk mitigation and strengthening local economic structures after crises (Kenkel et al., 2023; Osumba & Oboka, 2022). In the

context of MSME empowerment, cooperatives have been implemented as models to strengthen production capacity and expand market access, including through multi-stakeholder approaches that improve inclusivity among economic actors (Kinanti et al., 2024; Stuart et al., 2024b; Sugina et al., 2024). Studies on tourism villages and local economic digitalization have also demonstrated the potential integration of MSMEs with the tourism sector through increased destination visibility and the establishment of community-based business ecosystems (Nurhayati, 2025; Ramelan et al., 2024).

However, a review of existing literature reveals several consistent research gaps. Research on cooperative digitalization tends to focus on internal process efficiency (Chulkamdi et al., 2025; Stuart et al., 2022; Nurlaili et al., 2024), while MSME empowerment studies generally remain broad and sector-specific (Ibrahim et al., 2024; Sugina et al., 2024). Meanwhile, tourism village research frequently examines tourism development or MSMEs separately rather than integrating both perspectives (Nurhayati, 2025; Ramelan et al., 2024). To date, there has been limited development of an integrated conceptual framework that explicitly positions cooperatives as value chain orchestrators connecting MSME supply capacity with tourism demand through data analytics and AI support. Therefore, this research proposes a more comprehensive approach by developing an AI-based digital cooperative ecosystem integrated with tourism and local economic value chains. This approach not only supports cooperative digital transformation but also creates additional value and business opportunities for local economic actors.

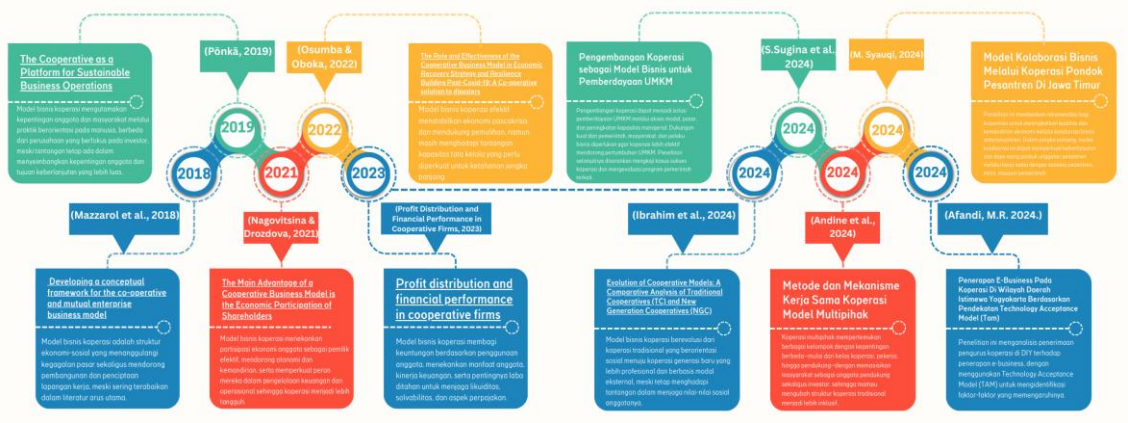
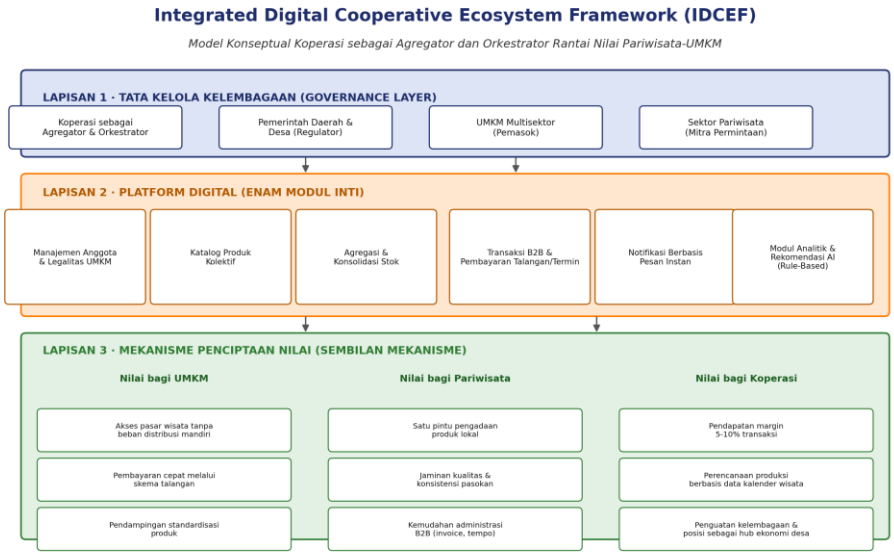


Figure 1. Position Map of Previous Research on Cooperative Business Model

The novelty offered in this study consists of three aspects. First, this study proposes a conceptual model of tourism-MSME production cooperatives that positions cooperatives as aggregators and consolidators within the value chain, rather than merely as savings and loan or operational entities. This model integrates the role of cooperatives into the value chain integration mechanism within the tourism sector (Kinanti et al., 2024). Second, this study introduces a cooperative-tourism-MSME hybrid Business Model Canvas based on value chain integration at the conceptual level, supported by a data-driven cooperative model approach for production planning. This approach differs from conventional cooperative models and sector-specific MSME digitalization models. Third, the Transdisciplinary approach involving local governments, village governments, MSMEs, and cooperatives as co-creators provides

methodological novelty in formulating a participatory cooperative-based economic model (Afandi, 2024; Syauqi, 2024).

To emphasize that these scientific contributions represent structured scientific artifacts rather than merely narrative proposals, all conceptual findings of this study were formulated into an integrated framework called the Integrated Digital Cooperative Ecosystem Framework (IDCEF), which is structured into three layers: institutional governance, a digital platform consisting of six modules, and value creation mechanisms, as presented in Figure 2. IDCEF functions as a reference model that can be adapted and replicated by other village cooperatives with similar tourism-MSME contexts. Furthermore, the framework has the potential to serve as a basis for Intellectual Property Rights (IPR) registration related to the resulting business model.



Gambar 2. Integrated Digital Cooperative Ecosystem Framework (IDCEF)

Based on this description, this study aimed to design and conceptually validate an Integrated Digital Cooperative Business Model that enables cooperatives to function as aggregators and consolidators of tourism-MSME products with the support of artificial intelligence (AI). This study also aimed to address the three research problem formulations through a case study of the Merah Putih Cikaso Village Cooperative in Kuningan Regency. This research represents the initial stage of a five-year research roadmap (2024–2031), which will proceed through subsequent stages, including advanced system and prototype design, AI implementation and integration, optimization and expansion, as well as downstream application and replication of the model at the district level in the following years.

METHOD

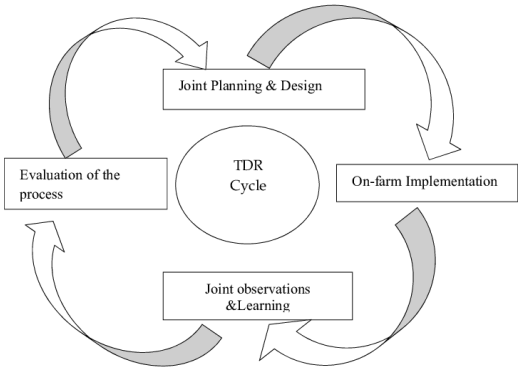


Figure 3. Adapted Transdisciplinary Action Research (TAR) Cycle

This study employed Transdisciplinary Action Research (TAR) combined with Living Lab and Human-Centered AI Design approaches to ensure active stakeholder involvement and alignment of the proposed model with the local context (Callery, 2022; Purwanto, 2025; Shneiderman, 2023). The research adopted a qualitative descriptive basic research design using a single-case study approach at the Cikaso Red and White Village Cooperative, Kramatmulya District, Kuningan Regency. The cooperative was selected as the research partner because of its role as a village-level pilot cooperative aggregator. The conceptual system development process followed the Waterfall framework, while modeling and data analysis were guided by the CRISP-DM framework (Yeza et al., 2025). The TAR cycle consisted of four phases: Joint Planning & Design, On-Site Implementation, Joint Observation & Learning, and Process Evaluation, which were integrated with the research stages covering needs assessment, market research, system analysis, strategy development, model design, system design, AI system development and modeling, user validation and testing, model optimization, finalization, and dissemination.

The Waterfall method was selected because the research remained at the conceptual and blueprint stages of high-level system design and did not involve iterative software development. Therefore, its sequential structure was considered more appropriate for documenting the transition from requirements analysis to system design. The Agile approach will be more applicable during the functional prototype development stage planned in the subsequent research roadmap. User validation was based on the Technology Acceptance Model (TAM) rather than the Unified Theory of Acceptance and Use of Technology (UTAUT), as this study focused on the initial conceptual acceptance of a digital cooperative model, including perceived usefulness and perceived ease of use, particularly among users with limited digital literacy. More complex UTAUT constructs, such as social influence and facilitating conditions, are recommended for evaluation after the platform has been operationalized and actual usage behavior can be measured.

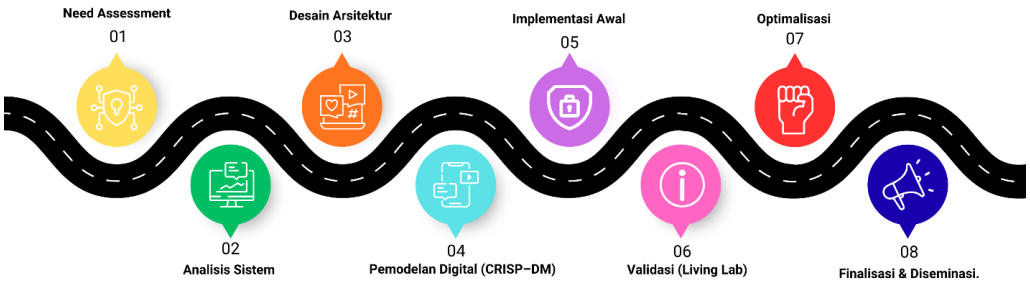


Figure 4. Eight Stages of the Main Flow of Research

The determination of informants employed a purposive sampling technique by selecting participants with direct knowledge and experience in cooperative management, MSMEs, and tourism development in Kuningan Regency. Data collection was continued until data sufficiency (data saturation) was achieved. Primary data were collected through in-depth interviews with 29 cross-stakeholder informants, consisting of five cooperative administrators, 15 MSME actors from various sectors (food, beverages, handicrafts, fashion, and agriculture), five tourism business managers/actors, and four government representatives from relevant agencies (the Cooperatives and SMEs Office, Tourism Office, Village Government, and Community and Village Empowerment Office). Additional data were obtained through one focus group discussion involving 10 cross-stakeholder participants, field observations at cooperative offices, MSME centers, and tourism village areas, as well as reviews of secondary documents, including cooperative AD/ART, membership data, and tourist visit data from the Tourism Office.

Exploratory quantitative data were collected through a digital readiness and platform needs questionnaire involving 45 MSME actors. The study also utilized expert judgment sheets from three experts representing cooperative economics and institutional development, information systems and AI, and tourism management, along with user validation questionnaires completed by 15 respondents during the Living Lab prototype trial stage.

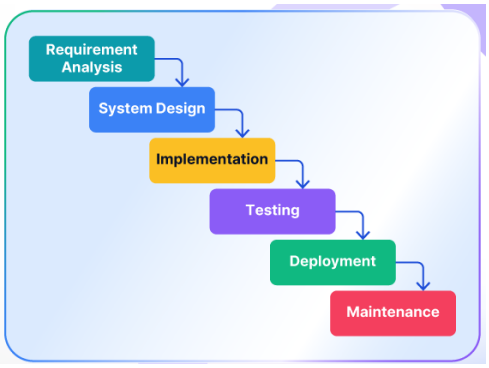


Figure 5. Stages of Waterfall Method for System Design

The research instruments consisted of ten components aligned with the research problem formulation: in-depth interview guidelines (Instruments 1–4), focus group discussion guidelines (Instrument 5), field observation sheets (Instrument 6), document review sheets (Instrument 7), digital readiness and MSME needs questionnaires (Instrument 8), expert validation sheets for conceptual models and prototypes (Instrument 9), and Technology

Acceptance Model (TAM)-based user validation questionnaires extended with an AI trust construct (Instrument 10). The validity of qualitative data was ensured through source triangulation involving cooperative administrators, MSMEs, tourism stakeholders, and government representatives, as well as methodological triangulation using interviews, observations, and document reviews. The validity of quantitative instruments was assessed using Aiken's V index ($V = \Sigma s / [n(c-1)]$), with three raters and a five-point rating scale.

Qualitative data were analyzed using thematic analysis of interview transcripts, focus group discussions, observations, and document reviews to identify problem patterns and user needs. Exploratory quantitative data were analyzed descriptively using mean scores from a 1–5 Likert scale. The business model was designed using a hybrid Business Model Canvas (BMC) developed through a Co-Creation process with stakeholders during the focus group discussion. The system architecture was designed based on Human-Centered Design principles, producing outputs in the form of Data Flow Diagrams and high-fidelity UI/UX mockups. AI modeling followed the CRISP-DM framework while considering limitations in historical MSME data availability as a basis for selecting the algorithmic approach. As this study was positioned at Technology Readiness Level (TRL) 2–3, technical achievement indicators, including AI model accuracy, were treated as initial feasibility indicators (proof of concept) for assessing conceptual model validity rather than as evidence of a commercially deployable production system.

RESULTS AND DISCUSSION

Interviews with five KDMP Cikaso administrators show that the cooperative has around 150-160 members and has carried out a simple aggregation function, collecting products from a number of MSME members before being marketed, but recording member data, products, stock, and transactions is still dominated by manual methods in the form of simple administrative books and worksheets, not yet *real time.* and are scattered in several separate documents. These findings are consistent with the obstacles identified by all management informants, namely variations in product quality, unstable MSME production capacity, and the absence of a digital system to monitor stock and demand in an integrated manner. The relationship between cooperatives and tourist destination managers is still incidental. Field observations at the Cikaso KDMP office, processed food MSME centers, and tourist village areas confirmed the findings of the interviews empirically: the cooperative office does not yet have a storage warehouse or storefront space to accommodate aggregated products, a collective product catalog is not yet available, and MSMEs are still distributing their products independently *(door-to-door).* The findings most relevant to the urgency of the study are a clear indication of a supply-demand imbalance: piles of bamboo handicrafts and dry food at production sites *(overstock* during quiet periods) go hand in hand with complaints of running out of local coffee in tourist cafes *(stockout).* This phenomenon empirically confirms that the fragmentation of the economic ecosystem of Kuningan village stems from the absence of an orchestration function that connects MSME production with the demand of the tourism sector, a supply chain paradox that can only be solved through the aggregation-consolidation function.

The perspective of the demand side was obtained from interviews with five tourism managers/business actors who confirmed the pattern of demand for local products that fluctuate

following the visiting season, with the experience *of stockout* in the high season and *overstock* in the low season. Relations with MSMEs are currently direct and fragmented. Tour managers take products from many MSMEs individually or through middlemen, which poses constraints on quality consistency, price uniformity, and delivery coordination. The most relevant findings for the formulation of the first problem (RM-1) emerged from the lodging sector informant who explained that the main obstacle is not solely the availability of products, but also the readiness of MSME administration (official invoices, business legality, term payment system) which is a prerequisite for the procurement of goods in the formal sector.

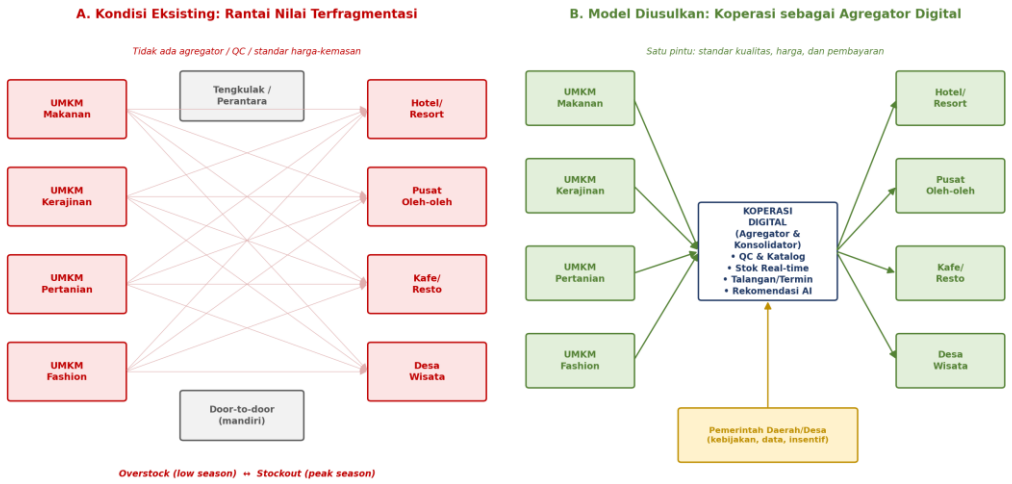


Figure 6. Value Chain Flow Comparison: Existing *Conditions (Fragmented)* and Proposed Model (Cooperatives as Digital Aggregators)

The *Focus Group Discussion* (FGD) agreement with 10 cross-stakeholder participants resulted in three key points: the repositioning of the role of cooperatives from just a savings and loan institution to a Marketing Aggregator *(Supply Chain Hub);* platform feature design focused on *business-to-business (B2B) mechanisms,* including standardized product catalogs, *real-time* stock management, and bailout payment systems (cooperatives pay cash in advance to MSMEs, while tourism parties pay with a tempo system to cooperatives) with a cooperative margin scheme of 5-10 percent; as well as a cross-sector data sharing mechanism, namely the tourism sector provides event calendars and visit trends as a production guide for MSMEs. Interviews with four representatives of government agencies also showed the alignment of policy directions. A questionnaire of 45 MSME actors across sectors (food/snacks, handicrafts, beverages/coffee, agriculture/livestock, and fashion/batik) produced three constructs of findings as presented in Table 2.

Table 2. Average Score of Digital Readiness and Digital Cooperative Platform Needs Questionnaire (N =

Construct	Highest Scoring Item	Lowest Scoring Items	Average Score Range
Digital Readiness	Willingness to learn new applications (4,2)	Regular sales and stock recording (2.5)	2,5 - 4,2
Platform Requirements	Collective marketing assistance (4,7)	Stock/sell monitoring dashboard (3.8)	3,8 - 4,7

Construct	Highest Scoring Item	Lowest Scoring Items	Average Score Range
Availability of Analytics Data	Willingness to share anonymous data (4,2)	Shareable sales records (2.6)	2,6 - 4,2

The pattern in Table 2 reveals the structural gap that is the basis for the main consideration in designing the system architecture: the infrastructure and willingness to learn of MSMEs are in the high category, but the actual practice of data recording and the use of *digital* platforms is still low. Therefore, the main obstacle to digital adoption is not limited infrastructure, but in operational habits and inadequate digital literacy. Correspondingly, all items in the platform needs construct obtained an average score above 3.8, with the highest requirement on the collective aggregation/marketing function and shared product catalog, which directly confirms the relevance of the cooperative model as an aggregator proposed in this study. The most crucial gap is found in the data availability construct: the willingness to share data is very high, but the availability of neat historical data is low, so the system cannot rely on MSME historical data and must be designed to start recording transaction data from zero *point (cold-start).* The thematic analysis of the questionnaire's open-ended content also identified the four main needs of MSMEs that appear most frequently: fast disbursement/bailout, ease of use of applications that resemble popular messaging applications, logistics assistance, and product packaging and licensing assistance that are direct references to determine feature priorities in the platform architecture design.

This pattern is relevant to be read through the perspective of platform ecosystem theory *(platform ecosystem theory),* which emphasizes that the success of digital platform adoption in the small business community is more determined by behavioral readiness and data governance *(governance readiness)* compared to the availability of purely technical infrastructure (Wegner dkk., 2023). In other words, the gap between the willingness to share data and the availability of neat historical data is not just a technical issue, but an indication that cooperatives need to first play the role of a member data governance coaching institution before playing the role of an analytics platform manager, in line with the cooperative's governance outlook *(cooperative governance)* which places strengthening member capacity as a prerequisite for the sustainability of the business model (Mazzarol dkk., 2018; Pönkä, 2019)

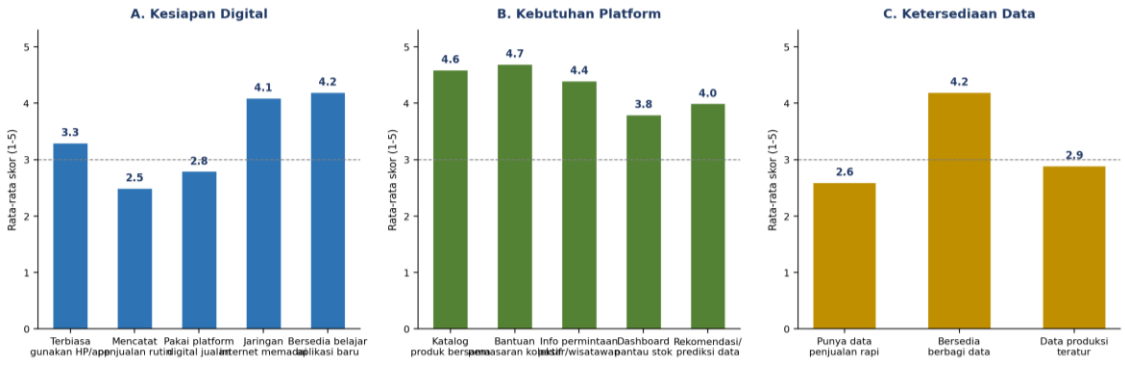


Figure 7. Average Score of the Digital Readiness and Platform Needs Questionnaire (Instrument 8, N = 45)

Based on the *findings of the Need Assessment*, the System Analysis and Model Design stage resulted in three main outputs: *a hybrid Business Model Canvas (BMC), a* system architecture blueprint, and an AI module design, all of which were compiled through *a Co-Creation process* with stakeholders at the FGD. The novelty of the proposed model lies in the placement of cooperatives as aggregators and consolidators in the value chain, rather than simply deposit-loan entities. *Value proposition* for MSMEs includes access to the tourism market without the burden of independent distribution, fast payment through bailout schemes, and assistance in product standardization; for the tourism sector, in the form of one-stop procurement of local products with quality assurance and ease of *business-to-business administration;* and for cooperatives in the form of a revenue margin of 5-10 percent of facilitated transactions. *Key activities* include aggregation and *quality control of* MSME products, collective catalog management, *demand-supply matching* based on the tourist calendar, and management of bailout and term payment schemes, while *key partners* involve the Cooperatives and SMEs Office, the Tourism Office, the Village Government, tourist destination and hotel managers, and local logistics service providers.

Figure 8. Business Model Canvas Hybrid Digital Cooperative - Tourism - MSMEs

Other *Business Model Canvas* blocks are also explicitly formulated through the *Co-Creation* process at the FGD. *Customer Segments* are divided into two sides: cross-sector MSMEs (food, beverages, handicrafts, fashion, agriculture) as supply partners, and managers of tourist destinations, lodgings, and cafes as *business-to-business demand partners. Channels* utilize digital channels (instant messaging-based applications as the main interface) which are strengthened with face-to-face channels through field assistance by cooperative administrators, considering the characteristics of MSME users who mostly have low digital literacy. *Customer Relationship* is built through a *personal assistance approach* from cooperative management to MSMEs (not *fully self-service*), combined with a regular feedback mechanism in member forums. *Key Resources* include the cooperative's membership base and legality, tourist visit calendar data from the Tourism Office, and the capacity of the human resources of the cooperative management as transaction orchestrators. *The cooperative's cost structure* consists of upfront payment bailouts to MSMEs, digital platform operational costs, and product

standardization assistance costs, while *Revenue Streams* rely on a transaction margin of 5-10 percent of the value of the goods facilitated, with the potential for the development of additional revenue streams from warehousing services and logistics consolidation at the advanced stage.

The platform architecture is designed following the *Waterfall* stages with a focus on conceptual levels and *high-fidelity UI/UX mockups*, including six core modules: member management and MSME legality, collective product catalogs, stock aggregation and consolidation, B2B transactions and bailouts/term payments, instant messaging-based simple notifications, and AI-based analytics and recommendation modules. The Data Flow Diagram places cooperatives as a single node *(hub)* that connects supply data from MSMEs with demand data from tourism partners. The interface design follows the principles of *Human-Centered Design* by taking into account the characteristics of MSME users, most of whom are elderly and have low digital literacy, including with enlarged font sizes, large input buttons, and simplified transaction flows.

AI modeling follows six stages of CRISP-DM. Responding to the gap in the availability of historical data of MSMEs (Table 2) identified as *cold-start problem*, The design of the AI model at this initial stage is geared towards an approach *Rule-Based Recommendation* simple that utilizes tourist visit calendar data from the Tourism Office as a basis for rules, for example, recommendations to increase local snack and coffee production ahead of peak visit periods (June-August) or weekends. This rule-based approach was chosen as a more realistic bridge compared to the *machine learning* conventional data that requires large amounts of historical data (Pournader dkk., 2021), as well as being the gradual foundation towards more complex predictive models once the platform's transaction database accumulates organically.

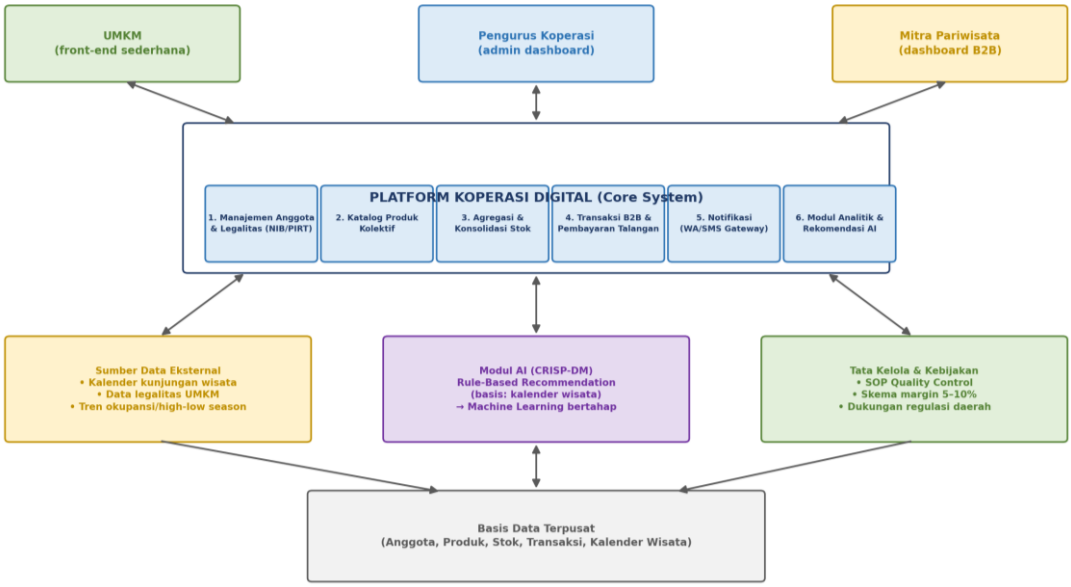


Figure 9. Blueprint of the Conceptual Architecture of an Integrated Digital Cooperative Platform

Validation of the model and prototype was carried out by three experts representing the fields of institutional/cooperative economics, information systems/AI, and tourism management, using a scale of 1-5, and analyzed with the Aiken's V index.

Table 3. Summary of Expert Validation of Conceptual Models and Prototypes (n = 3 validators)

Assessment Dimensions	Average Score	Aiken's V	Status
Position & suitability of cooperatives as aggregators	4,67	0,92	Valid
Precise interlinkage between model components	4,00	0,75	Valid
Completeness of features & feasibility of architectural blueprints	4,17	0,79	Valid
Feasibility of AI for predictions & recommendations	4,33	0,83	Valid
Compatibility of data-driven approach with field data	3,00	0,50	Revision
Clarity on the limitations of AI as an exploratory tool (PoC)	4,67	0,92	Valid
Novelty & contribution of the model	4,78	0,95	Valid

Eleven of the twelve items in the validation instrument obtained an Aiken's V index of ≥ 0.6 (valid category), with the highest score on the potential contribution of the model to strengthening the local economic ecosystem (V = 1.00) and on the clarity of the cooperative's position as an aggregator (V = 0.92). One item, namely the suitability of the *data-driven approach* with the availability of field data, obtained V = 0.50 and was categorized as needing revision, consistent with the quantitative findings in Table 2 that the initial design of AI was considered too ambitious when faced with the reality of the availability of MSME data that is still manual and unorganized. Qualitatively, the expert validator of cooperatives/MSMEs suggests the addition of *a physical Quality Control SOP* module because the digital system will not solve the problem if the standard of physical products of MSMEs has not been improved; the expert validator of the information system/AI recommends replacing *the machine learning* approach in the initial phase with *a rule-based recommendation algorithm* simple, recommendations that have been adopted in the design of the AI module; and tourism expert validators suggested the addition of *an integrated Calendar of Events* feature so that the system can provide early warning to MSMEs before the high visit period.

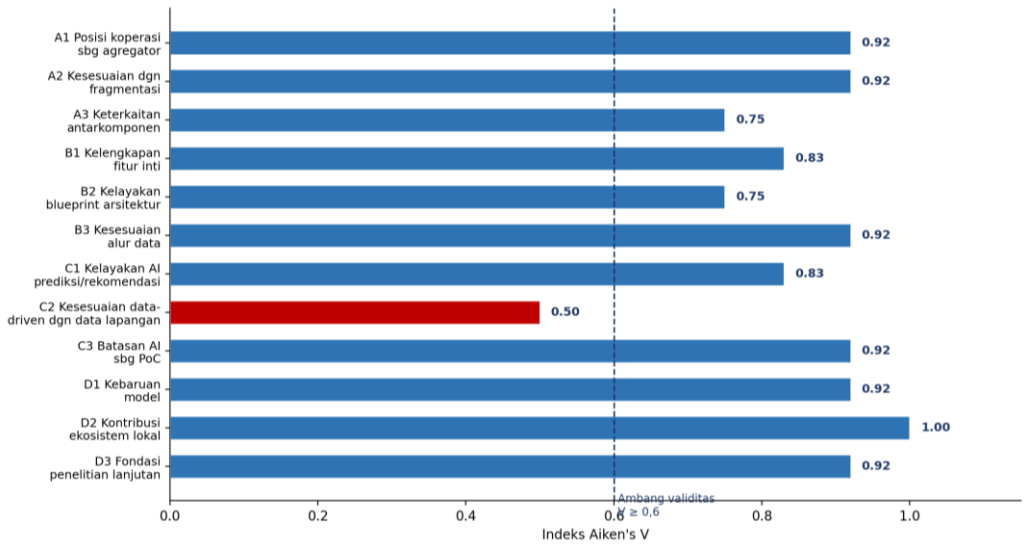


Figure 10. Aiken's V Index per Item Expert Validation of Models and Prototypes

The prototype trial was carried out through a *limited Living Lab* approach to 15 respondents consisting of cooperative administrators and representatives of MSMEs across sectors, using instruments that refer to the *Technology Acceptance Model (TAM) framework* which is expanded with a trust construct for AI. The results of the recapitulation are presented in Table 4.

Table 4. Recapitulation of Living Lab User Validation Results per TAM Construct (N = 15)

TAM Construction	Rerata	Category
Perception of Usefulness	4,63	Very High
Perception of Ease of Use	3,83	Height
Trust in AI Features	3,85	Height
Attitudes and Interest in Using	4,73	Very High
System Usability	4,03	Height

The construct of Attitudes and Interests in Using obtained the highest scores, driven by items regarding interest in using the system if further developed and favoring the concept of digital cooperatives, which showed a very strong initial acceptance of the idea of digital cooperatives conceptually, in line with the findings regarding technology acceptance models in the context of community-based organizations (Shneiderman, 2023).

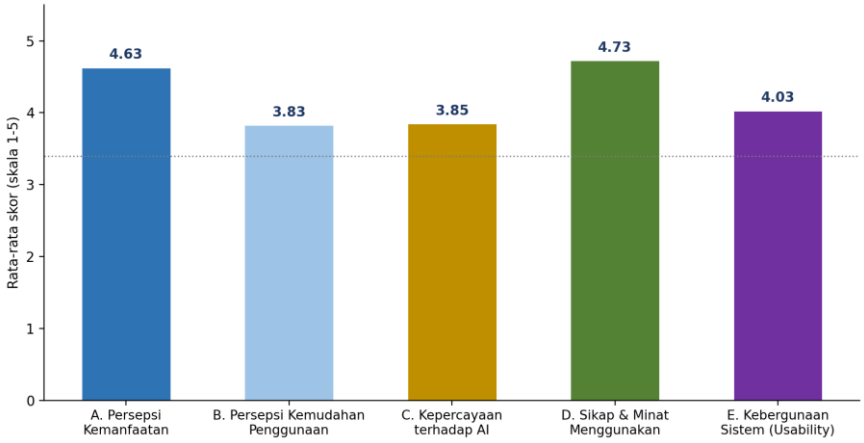


Figure 11. Average TAM Construct Score of Living Lab User Validation Results

The perception of usefulness is also high, especially because of the ease of collecting and displaying MSME products regularly. On the other hand, the Ease of Use Perception construct obtained a relatively lower score, consistent with the note that senior MSME actors still need adaptation in the early stages of use. In the Trust in AI Feature construct, the score was in the high category, but not as high as other constructs, in line with the finding that the concept of AI has not been fully technically understood by MSME users, although trust in the output of simple rule-based recommendations is quite good. The qualitative feedback confirmed two main improvement needs: clarity of payment status indicators on the cooperative *dashboard* display and the expansion of font sizes and input buttons on the MSME interface.

Regarding RM-1, findings *Need Assessment* which is strengthened by the support of all groups of informants empirically answering that the Integrated Digital Cooperative Business

Model is able to efficiently aggregate and consolidate MSME-tourism products if the cooperative is positioned as a single node that handles quality standardization, quantity consolidation, and simplification of payment administration between parties. Expert validation reinforces this conclusion conceptually, with the highest score precisely on the item of clarity of the cooperative's position as an aggregator. However, the validator's note that the success of digital aggregation depends on solving non-digital problems first, namely the standardization of the quality and packaging of physical products of MSMEs, emphasizes that the transformation of cooperatives as orchestrators of the village ecosystem cannot be achieved solely through technological interventions, but requires the accompaniment of institutional development and quality control SOPs, in line with the view that the sustainability of cooperative business models relies on participation and Governance of Members, Not Just Digital Instruments (Mazzarol dkk., 2018; Pönkä, 2019). These findings expand the theory of cooperative governance *(cooperative governance theory)* which has been emphasizing member participation as the basis for sustainability, pointing out that in the digital context, such participation needs to be expanded to include the willingness to share data and the discipline of record-keeping as a new form of institutional capital *(institutional capital).* In contrast to the view that positions cooperative digitalization solely as the efficiency of internal processes (Chulkamdi et al., 2025; Stuart et al., 2022; Nurlaili et al., 2024). These findings support the shift in the role of cooperatives to become ecosystem orchestrators as argued in the study *platform ecosystem* (Dawson dkk., 2024). It is important to note that the role of the orchestrator remains dependent on a solid foundation of non-digital governance.

Regarding RM-2, the higher economic value of digital cooperative integration is clearly illustrated in the high platform needs score, especially in cooperative assistance for collective marketing and shared product catalogs, which shows that MSME actors view digital aggregation as a direct path to expanding market access and increasing economic scale. The inn's manager's statement that the existence of the cooperative as an intermediary legal entity *business-to-business* will facilitate procurement and tax administration to indicate additional economic value in the form of reduced transaction costs on both sides of the market, consistent with the literature on digital collaborative platforms as a mechanism to reduce the cost of coordination between organizations (Dawson dkk., 2024; Wegner dkk., 2023). The FGD agreement on cooperative margin schemes and bailout payment mechanisms offers an incentive model that is empirically considered fair by all stakeholder groups, as well as a mechanism for cooperative financial sustainability. Very high score on the construct of Attitude and Interest in Using *Living Lab* It is an early indication that the value of this collaborative economy is perceived positively by potential users. However, measurements of real economic impact, increased revenue and volume of new transactions can be confirmed at the level of initial perception and receipt, thus requiring further research at the operational implementation stage. Theoretically, these findings support the logic of shared value creation *(value co-creation)* which places MSMEs, cooperatives, and the tourism sector as equal partners in the value creation process, not just passive beneficiaries of digital platforms. This pattern also expands *Service-Dominant Logic* to the realm of village cooperatives, by showing that economic value is not solely generated from buying and selling transactions, but from relational processes (bailout schemes, quality assurance, ease of administration) that are built collectively

through cooperatives as intermediaries of trust *(trust intermediary)* between MSMEs and the tourism sector.

Regarding RM-3, the most crucial finding is the gap between the willingness to share data with the availability of usable historical data, which is also reflected in the low validity of the approach suitability items *data-driven* with field data. This gap shows that the operationalization of AI in this business model cannot keep up with the *machine learning* conventional data that requires large amounts of historical data (Pournader dkk., 2021). So that this research operationalizes AI through the *rule-based recommendation* which utilizes available and valid external data, namely tourist visit calendar data, as a rule base to predict demand and personalize production recommendations. Results *Living Lab* suggests that this approach is pragmatically acceptable to users, although their technical understanding of AI concepts is still limited. This confirms that the success of AI operationalization in the context of village MSMEs is more determined by the simplicity of the output presentation than by the complexity of the methods behind it. Thus, RM-3 answers that AI can be effectively operationalized at an early stage through a simple and contextual rule-based approach, as a gradual foundation towards more complex predictive models once the platform's transaction database accumulates organically.

These findings differ from the mainstream of AI research on supply chains that tend to assume the availability of large amounts of historical data as a prerequisite for the application of predictive models (Pournader dkk., 2021) And vice versa supports the view *human-centered AI* which emphasizes that the suitability of AI with the user's context determines the success of adoption more than the sophistication of the algorithm alone. Thus, this study enriches the discourse on contextual AI design *(context-aware AI design)* in community-based organizations with data limitations, an area that has not been widely discussed in the AI literature for conventional supply chains.

The field findings confirm the three claims of novelty put forward in this study. First, the conceptual model of cooperatives as aggregators and consolidators (not just operational entities) has proven to be empirically relevant, as shown by the unanimous agreement across stakeholders at the FGD and the highest expert validation scores precisely on the aspect of cooperatives' position as aggregators, thus strengthening the argument that cooperatives can transform into ecosystem platforms, in line with the concept *of New Generation Cooperatives* emphasizing institutional adaptation to changes in the business and technological environment, Second, *the hybrid Business Model Canvas* based on tourism-MSME value chain integration is a direct derivative of field data that shows that the main problem is not in each sector separately, but at the interface between the supply side and the demand side, a gap that has not been widely discussed in the research on the digitalization of cooperatives and MSMEs that are sectoral. Third, a transdisciplinary approach involving local governments, villages, MSMEs, cooperatives, and the tourism sector as *co-creators* of value has been proven to result in feature design agreements (bailout schemes, cooperative margins, travel calendar data sharing) that are impossible to formulate only from a technological perspective, thus confirming the relevance of the multi-stakeholder approach in the formulation of cooperative-based economic models.

Some limitations need to be stated honestly in line with the *Evaluation of the Process* stage in the TAR cycle. First, all findings in this study are exploratory and conceptual according

to the TKT 2-3 target; AI performance indicators are set as initial feasibility indicators and not out-of-the-box system performance claims. Second, the limited availability of historical data of MSMEs limits the depth of analytical modeling that can be validated at this stage, so *rule-based* recommendations need to be reviewed after the real transaction database is collected. Third, the financial sustainability aspects of the model, the margin and bailout schemes, have only been validated at the normative agreement level in the FGD and have not been tested in quantitative cash flow simulations.

CONCLUSION

This research addressed three problem formulations. First, the Integrated Digital Cooperative Business Model demonstrated the potential to function as a tourism-MSME aggregator node through product standardization, consolidation, and simplification of transaction administration processes. Second, the integration of digital cooperatives, MSMEs, tourism, and AI showed potential to enhance economic value through expanded market access, transaction cost efficiency, and equitable incentive mechanisms, supported by high user acceptance during the Living Lab trial. Third, AI could be realistically applied through rule-based recommendation mechanisms based on tourist visit calendars as an initial step toward developing predictive models using machine learning.

Theoretically, this research contributed through the Integrated Digital Cooperative Ecosystem Framework (IDCEF), which positioned cooperatives as orchestrators of the tourism-MSME value chain and expanded the concept of cooperative participation through digital data sharing and shared value creation. Practically, this research produced a platform blueprint, AI module design, and governance recommendations that can serve as references for local governments, cooperatives, and MSMEs in developing a more integrated local economic ecosystem. However, the research remained at the conceptual and proof-of-concept stage (TRL 2–3), with a limited number of respondents and without quantitative economic impact assessment or financial feasibility testing. Therefore, future research should focus on developing functional prototypes at TRL 4–5, expanding user validation, conducting financial feasibility assessments, and gradually advancing AI capabilities from rule-based approaches toward machine-learning-based predictive models.

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