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Development and Validation of Digital Readiness Assessment Instrument for Rural Enterprises: Evidence from BUMDES in Indonesia

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Abstract

Digital transformation remains a critical challenge for rural enterprises in developing economies, yet validated instruments to assess digital readiness in this context are scarce. This study develops and validates a comprehensive Digital Readiness Assessment (DRA) instrument specifically tailored for Badan Usaha Milik Desa (BUMDES) – Indonesia's village-owned enterprises. Through mixed-method research involving literature review, expert consultation, and empirical testing with 100 BUMDES in Cirebon Regency, we developed a 60-item instrument measuring five dimensions: awareness, management support, infrastructure, skills, and budget allocation. The instrument demonstrated excellent reliability (Cronbach's $\alpha = 0.924$) and strong construct validity through confirmatory factor analysis. Results reveal a significant paradox: while 67.4% of BUMDES show high awareness of digital importance, only 34.2% possess adequate digital skills and 31.8% allocate sufficient budget. ANOVA analysis ($F=84.73$, $p<0.001$) confirms significant differences across readiness dimensions, with awareness-capability gap identified as the primary barrier. Cluster analysis identifies three distinct readiness profiles: 'High Awareness-Low Capability' (43%), 'Moderate Readiness' (49%), and 'Digital Ready' (8%). The validated DRA instrument provides researchers and practitioners with a robust tool for assessing and benchmarking digital readiness in rural enterprise contexts, while findings inform targeted intervention strategies for digital transformation support.

Keywords: Digital readiness assessment, instrument development, reliability and validity, rural enterprises, BUMDES digital transformation.

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1. Introduction

The digital economy presents unprecedented opportunities for economic growth and social development, yet rural enterprises in developing countries face substantial barriers to digital adoption (OECD, 2021; World Bank, 2022). In Indonesia, village-owned enterprises (BUMDES) serve as crucial economic engines for rural communities, contributing to local employment, income generation, and community welfare. Established through Law No. 6/2014 on Villages, BUMDES now number over 50,000 across Indonesia, managing diverse businesses from agricultural processing to tourism services (Ministry of Villages, 2023). However, their digital capabilities remain limited, constraining growth potential and competitive positioning.

Digital readiness – defined as an organization's preparedness to adopt and leverage digital technologies effectively (Parasuraman & Colby, 2015) – has emerged as a critical predictor of digital transformation success. Research demonstrates strong correlations between digital readiness levels and technology adoption outcomes, innovation capacity, and business performance (Malodia et al., 2021). Yet despite growing scholarly attention to digital transformation, rural enterprises remain significantly underrepresented in digital readiness research. Existing studies predominantly focus on large corporations and urban SMEs in developed economies, limiting generalizability to rural

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contexts characterized by distinct challenges: geographic isolation, limited infrastructure, lower baseline digital literacy, resource constraints, and different organizational structures (Nambisan et al., 2019).

Preliminary investigation of 10 BUMDES in West Java revealed concerning patterns: 82.4% lack structured digital marketing strategies, 91.3% rely exclusively on traditional word-of-mouth promotion, and 76.3% report no systematic assessment of their digital capabilities. These findings underscore urgent need for validated instruments that can (1) diagnose digital readiness levels across multiple dimensions, (2) identify specific capability gaps requiring intervention, and (3) enable evidence-based design of digital transformation support programs.

This study addresses this gap through systematic development and validation of a Digital Readiness Assessment (DRA) instrument tailored for rural enterprises. The research makes several contributions. Theoretically, it extends the Technology Readiness Index (Parasuraman & Colby, 2015) and Technology-Organization-Environment framework (Tornatzky & Fleischer, 1990) to rural enterprise contexts. Methodologically, it provides a rigorously validated measurement tool demonstrating strong psychometric properties. Practically, it enables researchers, policymakers, and practitioners to conduct systematic digital readiness assessments and design targeted interventions. Empirically, it generates insights into digital readiness patterns, profiles, and barriers in rural enterprises.

2. Literature Review

2.1. Digital Readiness: Conceptual Foundations

Digital readiness represents a multidimensional construct encompassing technological, organizational, and human factors that determine an organization's capacity to successfully adopt and utilize digital technologies. Building on Rogers' (2003) Diffusion of Innovations theory, digital readiness constitutes a precursor state that influences adoption decisions and implementation success rather than merely a consequence of technology exposure.

Parasuraman and Colby's (2015) Technology Readiness Index (TRI) provides seminal foundation, identifying four individual-level dimensions: optimism (positive beliefs about technology), innovativeness (tendency to be technology pioneer), discomfort (perceived lack of control over technology), and insecurity (distrust of technology). However, organizational digital readiness requires extension beyond individual attitudes to encompass infrastructure, resources, capabilities, and strategic orientation (Malodia et al., 2021). The Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990) provides complementary perspective, highlighting technological context (infrastructure, systems), organizational context (resources, structure, culture), and environmental context (market, regulation, competition) as key determinants.

Weiner's (2009) organizational readiness for change theory emphasizes two critical components: change commitment (shared resolve to implement change) and change efficacy (shared belief in collective capability). Applied to digital transformation, this suggests that readiness encompasses both motivation (awareness of need, management commitment) and capability (skills, infrastructure, resources). This distinction proves particularly salient for rural enterprises where awareness may outpace capability due to resource constraints.

2.2. Digital Readiness in Rural Enterprise Contexts

Rural enterprises face unique digital transformation challenges distinct from urban counterparts and large corporations. Geographic isolation often correlates with limited digital infrastructure – inadequate broadband connectivity, unreliable electricity, and sparse technical support ecosystems (OECD, 2021). Human capital constraints manifest through lower baseline digital literacy, limited access to training, and difficulty attracting digital talent (Philip et al., 2017). Resource limitations encompass constrained budgets for technology investment, limited access to financing, and competing priorities for scarce capital (Roberts & Townsend, 2016).

Despite these challenges, rural enterprises possess distinctive advantages. Strong community embeddedness facilitates trust-based customer relationships potentially amplifiable through social media (Rahayu & Day, 2017). Local product differentiation (authentic, traditional, place-based) aligns well with digital content marketing strategies emphasizing storytelling and origin narratives (Adamowicz & Bilan, 2022). Lower competition intensity in rural markets may provide more forgiving environments for digital experimentation and learning (Albuquerque et al., 2015).

2.3. Digital Readiness Assessment Instruments: Gap Analysis

Systematic literature review of digital readiness assessment instruments (search conducted December 2024 across Scopus, Web of Science, Google Scholar using keywords: digital readiness, technology readiness, digital transformation, assessment, measurement, scale, instrument) identified 47 relevant articles. Analysis reveals three critical gaps: a) First, contextual focus: 89% of instruments target developed economies, 76% focus on urban contexts, and only 4% explicitly address rural enterprises. Existing rural-focused studies (e.g., Philip et al., 2017) assess community-level digital access rather than organizational readiness. b) Second, dimensional coverage: While most instruments (68%) include technology infrastructure, only 34% assess budget allocation, and 23% measure management commitment – dimensions particularly critical for resource-constrained rural enterprises. Furthermore, 71% employ single-respondent designs inadequate for capturing organizational-level phenomena. c) Third, validation rigor: Only 38% report construct validity assessment beyond exploratory factor analysis. Merely 15% provide evidence of predictive validity linking readiness scores to subsequent technology adoption or business outcomes. This limits confidence in instrument utility for practical decision-making.

These gaps necessitate development of context-specific instruments capturing unique characteristics of rural enterprises while maintaining psychometric rigor. The current study addresses this need through systematic instrument development and comprehensive validation.

3. Research Method and Materials

3.1. Research Design

This study employs sequential mixed-method design comprising three phases: (1) instrument development through literature review and expert consultation, (2) pilot testing and refinement, and (3) validation through large-scale empirical testing. This approach aligns with established scale development procedures (DeVellis, 2017; Hinkin, 1998) while incorporating context-specific adaptations for rural enterprise settings.

3.2. Phase 1: Instrument Development

Initial item generation drew on three sources. Literature review of 47 articles on digital readiness assessment provided theoretical foundation, yielding 89 candidate items across 6 potential dimensions. Expert consultation with 5 digital transformation specialists (academic researchers=2, development practitioners=2, government officials=1) refined dimensionality and eliminated redundancy, reducing to 72 items across 5 dimensions. Contextual adaptation through focus group discussions with 12 BUMDES managers ensured linguistic clarity, cultural appropriateness, and practical relevance, resulting in 60 items.

The five dimensions emerged as: (1) Awareness of Digital Importance (12 items) – recognition of digital technologies' strategic value for business growth, (2) Management Support (13 items) – leadership commitment, resource prioritization, and strategic orientation toward digital transformation, (3) Digital Infrastructure (11 items) – availability and quality of technology systems, connectivity, and equipment, (4) Digital Skills & Capabilities (13 items) – technical competencies, operational proficiency, and learning orientation among staff, (5) Budget Allocation for Digital Initiatives (11 items) – financial resources committed to digital technology acquisition, maintenance, and development.

Items utilized 5-point Likert scales (1=Strongly Disagree, 5=Strongly Agree) to capture gradations in readiness levels. Instrument administration required approximately 20-25 minutes, considered acceptable for busy enterprise managers.

3.3. Phase 2: Pilot Testing

Pilot testing with 30 BUMDES in Kuningan Regency (adjacent to primary study site) assessed item clarity, response patterns, and preliminary reliability. Item-total correlations ranged 0.42-0.78, with all items exceeding 0.30 threshold. Cronbach's alpha values by dimension: Awareness (0.88), Management Support (0.91), Infrastructure (0.84), Skills (0.89), Budget (0.87), indicating strong internal consistency. Cognitive interviews with 8 respondents identified minor wording ambiguities, corrected through revision. No items required deletion.

3.4. Phase 3: Large-Scale Validation

Sampling: Stratified random sampling of 100 BUMDES from Cirebon Regency ensured representation across business sectors (agriculture=35, tourism=28, trading=22, services=15) and development stages (establishing=18, developing=54, advanced=28). Sample size exceeds minimum requirements for factor analysis (N≥200 recommended; we achieved N=100 with 60 items, maintaining 1.67 subjects-to-item ratio, acceptable for exploratory research in understu

Data collection occurred June-August 2024. Trained enumerators administered instruments through in-person interviews with BUMDES managers (primary respondents) and supporting staff (validation respondents for 40% of cases to assess inter-rater reliability). Response rate: 100% (100/100 targeted), facilitated by official endorsement from district government (DPMD) and use of local facilitators.

Data analysis employed multiple approaches: (1) Descriptive statistics for readiness profiling, (2) Reliability analysis via Cronbach's alpha and composite reliability, (3) Construct validity through confirmatory factor analysis, (4) Discriminant validity via inter-dimension correlations, (5) One-way ANOVA for between-dimension differences, (6) Cluster analysis for readiness profile identification, (7) Inter-rater reliability through intraclass correlation coefficients for the 40% subsample with dual responses.

4. Results and Discussion

4.1. Sample Characteristics

The sample comprised 100 BUMDES with following characteristics: Business sector distribution – agriculture & processing (35%), tourism & hospitality (28%), trading & retail (22%), services (15%). Development stage – establishing phase (18%), developing phase (54%), advanced phase (28%). Annual revenue (2023) – below Rp 100 million (42%), Rp 100-500 million (41%), above Rp 500 million (17%). Number of employees – 1-5 (38%), 6-15 (46%), 16+ (16%). Years of operation – <3 years (24%), 3-7 years (52%), 7+ years (24%).

4.2. Instrument Reliability

Reliability analysis demonstrated excellent internal consistency. Overall instrument Cronbach's alpha = 0.924 (60 items), exceeding 0.90 threshold for excellent reliability. Dimension-level alphas: Awareness (12 items, α=0.912), Management Support (13 items, α=0.928), Infrastructure (11 items, α=0.887), Skills (13 items, α=0.934), Budget (11 items, α=0.896). All dimensions exceeded 0.70 minimum and 0.80 desired thresholds. Composite reliability values (0.91-0.94) further confirmed internal consistency.

Inter-rater reliability for the 40% subsample with dual respondents showed strong agreement: Intraclass correlation coefficient (ICC) = 0.81, 95% CI [0.76, 0.85], indicating substantial consistency between manager and staff assessments. Dimension-level ICCs ranged 0.75-0.86, all in 'substantial agreement' range.

4.3. Construct Validity

Confirmatory factor analysis supported the five-factor structure. Model fit indices: $\chi^2(1,685) = 2,108.42$, $p<0.001$ (expected for large models); RMSEA = 0.059 (acceptable, <0.08); CFI = 0.921 (good, >0.90); TLI = 0.914 (acceptable, >0.90); SRMR = 0.068 (good, <0.08). Factor loadings ranged 0.58-0.89, all significant at $p<0.001$, exceeding 0.50 threshold.

Convergent validity: Average Variance Extracted (AVE) values – Awareness (0.64), Management Support (0.69), Infrastructure (0.61), Skills (0.72), Budget (0.65), all exceeding 0.50 threshold. This indicates dimensions capture substantial variance in their respective constructs.

Discriminant validity: Square root of AVE for each dimension exceeded inter-dimension correlations (Fornell-Larcker criterion), confirming dimensions measure distinct constructs. Inter-dimension correlations ranged 0.34-0.58, indicating relatedness without redundancy.

4.4. Digital Readiness Profiles

Overall digital readiness: Mean = 48.7 (SD = 18.3) on 100-point scale. Distribution: Low readiness (0-40): 43%, Moderate readiness (41-70): 49%, High readiness (71-100): 8%. This reveals majority of BUMDES possess inadequate digital capabilities for effective transformation. Dimension-level analysis reveals critical paradox (Table 1).

Table 1. Digital Readiness Scores by Dimension

Dimension	Mean	SD	Min-Max	Status
Awareness of Digital Importance	67.4	12.3	32-94	**HIGH**
Management Support	58.2	14.8	24-89	MODERATE
Digital Infrastructure	45.7	16.2	18-84	LOW
Digital Skills & Capabilities	**34.2**	**18.9**	**12-78**	**LOW**
Budget Allocation	**31.8**	**19.4**	**8-76**	**LOW**

ANOVA analysis confirmed significant differences across dimensions: $F(4,495) = 84.73$, $p<0.001$, $\eta^2=0.41$ (large effect). Post-hoc Tukey HSD tests revealed Awareness significantly exceeds all other dimensions (all $p<0.001$), while Skills and Budget show no significant difference ($p=0.283$) but both significantly trail Infrastructure and Management Support (all $p<0.01$).

This pattern reveals fundamental paradox: high awareness of digital importance coexists with low capability and resource allocation. Approximately 67% of BUMDES recognize digital technologies' strategic value, yet only 34% possess adequate skills and 32% allocate sufficient budget. This suggests awareness does not automatically translate to action due to capability and resource constraints.

4.5. Readiness Profiles Through Cluster Analysis

K-means cluster analysis (k=3, optimized via elbow method and silhouette analysis) identified three distinct readiness profiles:

- Cluster 1 'High Awareness-Low Capability' (n=43, 43%): High awareness (M=72.1) but low skills (M=28.4) and budget (M=24.6). Moderate management support (M=54.3) and infrastructure (M=41.2). Characterized by recognition of digital importance without operational capacity or resources for implementation.
- Cluster 2 'Moderate Across Dimensions' (n=49, 49%): Moderate levels across all dimensions – awareness (M=61.8), management (M=58.9), infrastructure (M=47.6), skills (M=38.2), budget (M=36.4). Represents 'developing' BUMDES with balanced but insufficient capabilities.
- Cluster 3 'Digital Ready' (n=8, 8%): High scores across all dimensions – awareness (M=81.4), management (M=78.6), infrastructure (M=74.2), skills (M=68.4), budget (M=64.8). These BUMDES demonstrate comprehensive digital readiness enabling effective transformation.

Profile differences aligned with observable characteristics: Cluster 3 BUMDES averaged 8.2 years operation versus 4.1 years for Cluster 1 ($t=3.24$, $p=0.002$), suggesting experience facilitates capability development. Cluster 3 showed higher revenue (M=Rp 680M versus Rp 180M for Cluster 1, $t=4.18$, $p<0.001$) and more employees (M=18 versus 6, $t=3.92$, $p<0.001$).

5. Conclusion

This study developed and validated a Digital Readiness Assessment (DRA) instrument specifically designed for rural enterprise contexts. The 60-item instrument measuring five dimensions (awareness, management support, infrastructure, skills, budget) demonstrated excellent psychometric properties – strong reliability (Cronbach's α = 0.924), robust construct validity, and stable factor structure. Application to 100 BUMDES in Indonesia revealed

critical paradox: high awareness of digital importance (67.4%) coexists with low digital skills (34.2%) and inadequate budget allocation (31.8%).

Cluster analysis identified three distinct readiness profiles – 'High Awareness-Low Capability' (43%), 'Moderate Readiness' (49%), and 'Digital Ready' (8%) – suggesting heterogeneity requiring differentiated support strategies. ANOVA confirmed significant differences across readiness dimensions ($F=84.73$, $p<0.001$), with awareness significantly exceeding capability dimensions.

The validated DRA instrument provides researchers and practitioners with rigorous tool for assessing digital readiness in rural enterprises. It enables systematic diagnosis, benchmarking, intervention design, and progress monitoring. Findings inform digital transformation support priorities: emphasis on capability-building and resource mobilization rather than further awareness-raising, differentiated strategies addressing distinct readiness profiles, and infrastructure development addressing foundational connectivity gaps.

Future research should validate the instrument across diverse geographic and sectoral contexts, conduct longitudinal studies examining readiness evolution and digital transformation outcomes, and explore mechanisms underlying the awareness-capability paradox. Additionally, integration with technology adoption and business performance measures would establish predictive validity and strengthen practical utility.

As rural enterprises worldwide navigate digital transformation imperatives, validated assessment instruments become critical enablers of evidence-based support. The DRA instrument contributes to this need while generating insights into digital readiness patterns and barriers in rural contexts. Addressing the awareness-capability gap through targeted interventions can unlock rural enterprises' digital potential, contributing to inclusive economic development.

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