

Intelligent Mobile-Spatial System for Small Business Digital Innovation in Lubuk Linggau

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ABSTRACT

Micro, small, and medium enterprises (MSMEs) in Lubuklinggau City face digitalization barriers caused by the absence of an integrated, location-based business database and an objective basis for prioritizing digitalization programs. This study designed, built, and tested a mobile- and spatial-based information-system prototype integrating a Geographic Information System, a mobile-first responsive web application, and a Simple Additive Weighting (SAW)-based decision-support module with five digital-readiness criteria, deployed and populated with 50 MSME records across six sub-districts (about 0.51% of the 9,746 MSMEs on the city's official business portal). Three kinds of evidence are reported separately: computational verification, in which system-generated preference values agreed exactly with an independent manual recalculation for all 50 records; software testing, in which 18 functional cases and 8 role-based access-control scenarios passed after two defects found in development-team testing were corrected and re-verified; and preliminary, non-generalizable feedback from a single development-team respondent. Because the active weights are an unelicited uniform placeholder, a sensitivity analysis recomputed rankings under four alternative weight scenarios: 66% of MSMEs changed maturity class under at least one scenario, and one cost-priority scenario retained only 2 of the baseline top-10 MSMEs, showing that the ranking is materially sensitive to weight choice. These results demonstrate implementation correctness and functional behavior under the tested conditions; they do not establish the criteria, weights, or thresholds as a validated policy instrument, nor system-wide technical readiness, both requiring further evaluation described in the conclusion.



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1. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are a strategic sector that sustains regional economies through employment absorption and household income growth. Digital transformation has been shown to strengthen daily operations, expand market access, and improve business efficiency [1]; however, most MSMEs still face adoption barriers such as low digital literacy, limited infrastructure, and high implementation costs [2]. In Lubuklinggau City, these barriers are compounded by three

specific problems: MSME data are not yet integrated or location-based, making spatial analysis difficult; business information access for consumers and stakeholders remains limited; and digitalization-program prioritization is not yet grounded in a measurable, objective assessment.

This section synthesizes a narrative, non-systematic review of literature on Geographic Information Systems (GIS) for MSME mapping, mobile applications for MSME management, and spatial decision support; it is not a systematic review with a predefined search protocol, and the resulting gap statement below should be read as a synthesis of the sources examined rather than an exhaustive survey of the field. A GIS is a computer-based system for acquiring, storing, analyzing, and presenting geographically referenced data [3], and it has been used to visualize MSME spatial distribution [4]. Mobile-based applications strengthen MSME operational management and marketing through business-data, promotion, and reporting features [5]. Spatial Decision Support Systems (DSS), which combine data and models to help decision-makers address semi-structured problems [6], can provide strategic, data-driven recommendations for regional MSME development. Table 1 positions the present system against representative examples of each solution category found in the reviewed literature.

Table 1. Positioning of the present system against representative prior systems

System (source)	Data source	Spatial capability	Decision method	Validation reported	Deployment
WebGIS MSME mapping [4]	Field survey	Yes (Leaflet WebGIS)	None (visualization only)	Not reported	Regency-level deployment
Mobile MSME management app [5]	Literature synthesis	No	None	Not reported	Conceptual/reviewed apps
Institutional SAW-DSS [7]	Institutional records	No	SAW	Computational only	Single institution
Present system	Field survey + self-report	Yes (Leaflet WebGIS)	SAW	Computational verification + black-box testing	City-scale prototype, 50 records

Among the sources reviewed, GIS-based MSME mapping studies typically stop at visualization without generating a decision, mobile-application studies rarely incorporate a spatial dimension, and DSS studies for MSMEs are usually not linked to business location; none of the reviewed sources combines all three capabilities in one deployed system, which is the gap this study addresses architecturally rather than through a novel algorithm.

Among multi-attribute decision-making (MADM) methods, Simple Additive Weighting (SAW) computes a weighted sum of normalized performance ratings across criteria for each alternative [6]. SAW has previously been applied to institutional multi-criteria decisions, such as ranking candidates in a staff-recruitment decision support system [7]. SAW was selected over alternatives such as AHP, TOPSIS, or MOORA primarily for its transparency: unlike AHP's pairwise-comparison procedure or TOPSIS's distance-to-ideal-solution calculation, SAW's weighted-sum computation can be reproduced by a stakeholder with a spreadsheet, which was judged important given that the ranking may influence eligibility for a limited assistance program. This choice carries a known trade-off, discussed in the Method and Discussion sections: SAW is fully compensatory, so a severe weakness on one criterion can be masked by strength on others, a property that AHP and TOPSIS do not eliminate but that non-compensatory or veto-threshold approaches are designed to address.

This study addresses the identified gap by designing, building, and testing a prototype mobile- and spatial-based information system that integrates a GIS, a mobile-first responsive web application, and a SAW-based decision-support module, evaluated in the context of MSMEs in Lubuklinggau City. The contribution is scoped specifically as (i) a system architecture and data model that keep spatial attributes and multi-criteria assessment on a single MSME entity, avoiding the record-linkage step that separate mapping and scoring systems require, and (ii) a location-linked recommendation mechanism derived from per-criterion deficits. The study reports computational verification and software-testing evidence for this architecture on 50 real MSME records; it does not claim that the resulting rankings have been validated as a policy instrument, nor does "intelligent" in the title imply learning or adaptive behavior

beyond the deterministic, rule-based SAW computation, a scope limitation stated here to align the terminology with the evidence presented.

2. RESEARCH METHOD

This study used a Research and Development (R&D) approach with a prototyping model, integrating software engineering, Geographic Information System (GIS) development, and Decision Support System (DSS) design. The prototyping model was chosen because prospective users find it difficult to articulate their needs in the abstract, yet provide sharp, actionable feedback once they can interact with a working interface [8]. The research therefore proceeded through iterative cycles of requirements gathering, rapid design, prototype construction, user evaluation, and refinement; the prototype was deployed to a working environment for the data collection and testing reported here, a deployment status distinguished from a production system released for unsupervised public use.

2.1. Research Stages

The research was carried out through eight stages: problem identification and literature review; collection of MSME and spatial data through field observation and surveys; data validation; requirements analysis and prototype design; system development using React and TypeScript with a cloud-based backend and the Leaflet digital mapping library; implementation of the SAW method; system testing; and refinement together with reporting.

Reconstructed from the project's version-control history, the prototype underwent 18 commits across a 52-hour window immediately preceding and overlapping data collection (2026-08-15 16:38 to 2026-08-17 20:29, UTC+7), which can be grouped into four development iterations. Iteration 1 (15-16 August, morning) produced the initial working prototype and resolved production-deployment defects (database-schema migration, environment configuration). Iteration 2 (16 August, afternoon-evening) added region-management functionality and fixed two defects surfaced during this phase: a coordinate-entry field dropping the minus sign, and a business-detail page that stalled indefinitely on "Loading..." when access was denied - the latter matching, by commit message and timestamp, the access-control defect independently reported in Section 3.5. Iteration 3 (17 August, morning) added self-service MSME registration without login (enabling the owner-self-reported records described above); within 30 minutes, its route and on-screen label were both revised (from "/daftar-mandiri" and "Register Your MSME" to "/kuesioner" and "Your MSME Profile"), consistent with immediate naming feedback during first use rather than a separate elicitation session. Iteration 4 (17 August, afternoon-evening) corrected a dashboard display defect and a pagination defect and added an administrative user-access feature; these three commits followed the 13:37 computation run reported in Section 3.2 and therefore postdate, rather than affect, the reported 50-record results. No formal meeting minutes, elicitation protocol, or named stakeholder attribution beyond what is inferable from commit timing and messages were kept; the full 18-commit log with hashes, timestamps, and messages is provided as Supplementary Material S3 for independent verification.

2.2. Participants and Research Setting

The system serves three user roles that also correspond to the study's participant groups: administrators, who manage criteria, weights, and user accounts; surveyors, who collect and validate field data; and MSME owners, who view their own business data and recommendations. The research setting was Lubuklinggau City, South Sumatra Province, Indonesia.

Reconstructed from the system's audit log, field data collection was concentrated on 2026-08-17 (169 of 176 logged record-level actions), preceded by an initial pilot batch on 2026-08-16 and followed by a small number of late self-entered records on 2026-08-18 and 2026-08-19; the log distinguishes surveyor-entered actions from owner-self-entered ("mandiri") actions, independently corroborating the two collection modes described below.

As of the data-collection period, the city's official MSME directory (Linggau Smart Service portal, <https://lss.lubuklinggaukota.go.id/frontend/umkm>) listed 9,746 registered MSMEs across 8 sub-districts. The final analytic sample comprised 50 MSMEs distributed across 6 of these 8 sub-districts, representing approximately 0.51% of the registered population. The remaining two sub-districts had not yet been reached by field surveyors when data collection was concluded for this study; their absence

reflects incomplete field coverage rather than a deliberate exclusion criterion. Given this coverage and the purposive selection described below, the sample should be read as a feasibility demonstration of the system on real records, not as a statistically representative cross-section of the city's MSME population, and all prevalence figures reported in the Results section are specific to this sample. Data collection was conducted by two field surveyors, who divided sub-districts between them; in a subset of cases, business owners were asked to complete the digital-readiness questionnaire directly on the system themselves rather than through a surveyor interview. Because the two surveyors worked on non-overlapping sub-districts and did not double-score a common set of MSMEs, inter-rater agreement was not measured, and consistency across surveyors and self-reported entries relied on the standardized rubric described in the Instruments subsection rather than on a formal reliability statistic; this is acknowledged as a limitation in the Conclusion. MSMEs were included if the business operated at a fixed, geolocatable premise within the city, was actively operating, and the owner or manager consented to participate.

Because the system records business identity and precise geolocation and exposes this information through maps and role-scoped API responses, participants were informed before data collection that their business information and location would be recorded and managed within the system. This study was conducted as part of an academic project with the awareness and oversight of Universitas Bina Insan; a separate independent ethics-committee review was not obtained, and consent was collected as verbal, informed awareness of data collection and system storage rather than a signed instrument that separately itemized map publication, retention period, or anonymization options. This falls short of a documented informed-consent and data-governance protocol, and we report it explicitly as a limitation: consent to participate in data collection is not equivalent to documented consent to publish precise geolocation, and future iterations of this work should obtain formal institutional ethics review and an explicit, itemized consent instrument before expanding data collection or public-facing deployment.

2.3. Instruments and Data Sources

Data were collected using an MSME registration form (business identity, location, and category) and a digital-readiness assessment form covering five criteria: business owner digital readiness (C1), social-media utilization (C2), presence of online business channels (C3), digital transactions (C4), and implementation cost (C5). The first four criteria are benefit-type criteria, while the fifth is a cost-type criterion, confirmed operationally as follows: a higher raw C5 score corresponds to lower implementation cost on a 1-5 rubric scale, so C5 is normalized as a cost-type criterion using the minimum-based rule in equation (1) even though its scoring direction already runs from expensive (1) to inexpensive (5); each criterion was scored on this 1-5 scale using a standardized rubric administered identically to surveyor-collected and owner-self-reported records to keep assessments as consistent as the instrument allows across collection modes. The complete wording of all five rubrics is given in Table 2; each rubric was authored by the development team by adapting general digital-readiness indicators to the MSME context and was not separately validated by an external panel or piloted for content validity prior to use, a limitation acknowledged in the Conclusion.

Table 2. Digital-readiness rubric (1-5 scale) for all five criteria

Criterion	1	2	3	4	5
C1 Owner readiness	Never used digital tools for business	Owens a smartphone, personal use only	Uses basic apps (chat, calculator) occasionally for business	Regularly uses several digital apps for business	Independently uses varied digital apps, open to learning new ones
C2 Social media	No business social-media account	Has an account, inactive	Posts business content irregularly	Posts regularly on a fairly fixed schedule	Posts on a fixed schedule and interacts with customers
C3 Online presence	No online channel at all	Listed on one channel, unmanaged	Listed on one channel, actively managed	Listed on two channels, actively managed	Listed on more than two interlinked channels

Criterion	1	2	3	4	5
C4 Digital transactions	Cash only	Digital payment accepted incidentally	One digital payment channel offered consistently	More than one digital payment channel, used routinely	Majority of transactions digital and recorded
C5 Implementation cost	Very high cost for next digitalization step	High cost	Moderate cost	Low cost	Very low or no cost required

2.4. Data Analysis Technique

Multi-criteria analysis was performed using the Simple Additive Weighting (SAW) method [6]. Let $A = \{A_1, \dots, A_m\}$ denote the m MSMEs (alternatives) and $C = \{C_1, \dots, C_n\}$ the $n = 5$ criteria, with raw score x_{ij} for alternative i on criterion j . Weights w_j satisfy $0 \leq w_j \leq 1$ and $\sum w_j = 1$ for $j = 1..n$. Each criterion is normalized according to its type, as shown in equation (1).

$$r_{ij} = x_{ij} / \max_i(x_{ij}) \text{ for benefit criteria; } r_{ij} = \min_i(x_{ij}) / x_{ij} \text{ for cost criteria} \quad (1)$$

The preference value of each alternative is computed as the weighted sum of the normalized matrix, as shown in equation (2), where V_i is the preference value of the i -th MSME, w_j is the weight of the j -th criterion, and r_{ij} is the normalized value of the i -th MSME on the j -th criterion.

$$V_i = \sum (w_j \times r_{ij}), \text{ for } j = 1 \text{ to } n \quad (2)$$

Because $\max_i(x_{ij})$ and $\min_i(x_{ij})$ in equation (1) are taken over the current alternative set, normalized scores - and therefore V_i and the resulting ranks - are defined relative to whichever MSMEs are included in a given computation run; adding or removing an MSME can shift the reference maximum or minimum on a criterion and change other alternatives' normalized scores and ranks even though their own raw values are unchanged. Records with an incomplete rubric score on any criterion are excluded from the run rather than imputed, and no zero-denominator case arises in equation (1) because the 1-5 rubric floor excludes a raw value of zero. Ties in V_i are resolved by standard competition ranking: alternatives with an identical V_i receive the same rank, and the next distinct value skips the number of tied alternatives - the rule that produced the skipped rank reported in the Results.

Independent computational verification was performed by an author who re-implemented equations (1) and (2) in a separate spreadsheet from the exported raw x_{ij} values, working from the system's stored raw scores rather than a blinded dataset; agreement was defined as a difference of no more than 0.0001 in V_i and an identical rank order. This procedure verifies that the software correctly implements the stated formulas; it is computational verification, not decision-model validation, and does not by itself establish that the chosen criteria, weights, or thresholds reflect stakeholder priorities or predict a meaningful external outcome, a distinction maintained throughout the Results and Discussion. Functional black-box testing and role-based access-control testing were carried out by the development team directly against the deployed prototype, covering both user-interface interaction and direct calls to the application programming interface (API), in order to verify that rules were enforced on the server side rather than merely hidden in the interface [9]; no independent or third-party security tester was engaged, and the scope of security-relevant testing performed is stated precisely in the Results.

3. RESULTS AND DISCUSSION

This section reports three distinct kinds of evidence - system design, computational verification of the SAW implementation, and software testing - followed by preliminary, non-generalizable user feedback and a discussion that relates these findings, and their limits, to prior research.

3.1. System Design and Implementation Results

The system was built on a four-layer architecture - presentation, map, service and logic, and data - serving three user roles with tiered access rights: administrator, surveyor, and MSME owner, as illustrated in Fig. 1. The main modules include MSME data management, versioned criteria-and-weight management, the SAW computation engine, a Leaflet-based distribution map, and a recommendation bank that the administrator can edit without redeploying the application. Access rights were designed so

that an MSME owner can view only their own business data, while surveyors and administrators receive access commensurate with their respective authority.

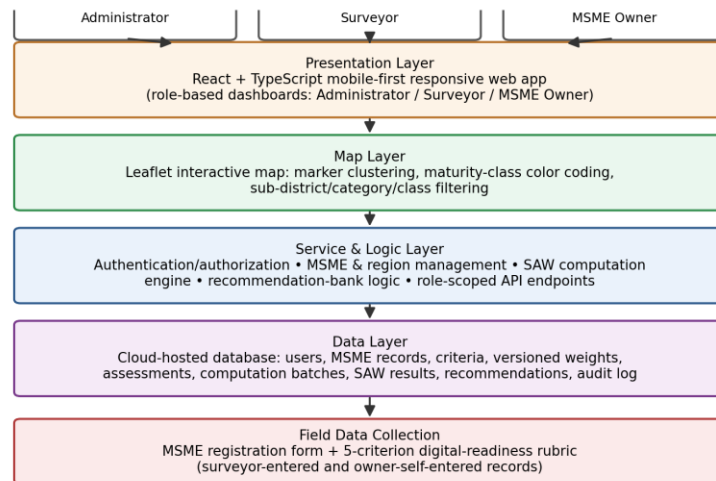


Figure 1. Four-layer system architecture with role-based access and field data-collection flow

The recommendation-bank content mapping each criterion-and-class combination to a specific suggested action was authored directly by the development team, drawing on general MSME digital-assistance practice rather than a documented expert panel; conflicting recommendations across simultaneously deficient criteria are resolved by listing all triggered suggestions rather than by an automated prioritization rule, and the quality or relevance of the recommendations has not been separately validated with MSME owners or assistance-program staff, a gap noted alongside the user-acceptance limitation in the Conclusion.

3.2. SAW Computation Verification Results

The weight set active during data collection was uniform (0.20 for each criterion) and the maturity-class thresholds were set at 0.66 and 0.33; both are provisional placeholders adopted because definitive weights and thresholds have not yet been elicited from stakeholders through the stakeholder focus-group process anticipated in the project design, and neither has a theoretical or empirical basis beyond this uniform default. Consequently, the class counts and rankings reported below describe how the current placeholder configuration behaves on this sample; the following subsection reports a sensitivity analysis quantifying how much this specific configuration matters. All raw criterion values for the 50 MSMEs were exported and independently recomputed using equations (1) and (2), then compared against the preference values stored by the system, following the verification protocol described in the Method section. The verification results are summarized in Table 3.

Table 3. Summary of SAW computation verification on 50 MSMEs

Aspect	Result
MSMEs verified	50
V values in agreement (difference ≤ 0.0001)	50 (100%)
Highest V value	0.8800
Lowest V value	0.2900
High class (placeholder threshold)	21 MSMEs
Medium class (placeholder threshold)	27 MSMEs
Low class (placeholder threshold)	2 MSMEs

All 50 preference values agreed exactly with the manual recalculation, confirming that the software correctly implements equations (1) and (2) as specified; this is computational verification of the implementation, not validation of the ranking's decision quality. A worked example illustrates the full computation: for one MSME (a photography studio) with raw scores $C1=5$, $C2=5$, $C3=3$, $C4=4$, $C5=1$, and sample extremes $\max(C1..C4)=5$ and $\min(C5)=1$, equation (1) gives $r=(1.000, 1.000, 0.600, 0.800, 1.000)$, and equation (2) gives $V_i = 0.20 \times (1.000 + 1.000 + 0.600 + 0.800 + 1.000) = 0.880$, matching the highest value in Table 3. Three MSMEs shared an identical V value (0.8667) and were jointly assigned

rank 2 under the standard competition-ranking rule defined in the Method section, with the next distinct value skipping to rank 5. Two MSMEs fell below the 0.33 placeholder threshold into the Low class. The complete 50-record raw-score matrix and computation output are available from the corresponding author on reasonable request.

3.3. Sensitivity Analysis Across Alternative Weight Scenarios

Because the active weights are an unelicited placeholder (Section 3.2), the exported 50-record raw-score matrix was used to recompute rankings and classes under four alternative weight scenarios in addition to the reported uniform baseline, using the identical equations (1) - (2) and thresholds (0.66/0.33): a readiness-weighted scheme emphasizing C1 (0.35/0.15/0.15/0.15/0.20), a cost-priority scheme emphasizing C5 (0.10/0.10/0.10/0.10/0.60), an online-presence-priority scheme emphasizing C3 (0.15/0.15/0.40/0.15/0.15), and a transaction-priority scheme emphasizing C4 (0.15/0.15/0.15/0.40/0.15). Table 3b summarizes the resulting class distribution and the overlap between each scenario's top-10 ranked MSMEs and the baseline top-10.

Table 3b. Class distribution and top-10 overlap under alternative weight scenarios

Scenario	High	Medium	Low	Top-10 overlap with baseline
A. Uniform (reported baseline)	21	27	2	10/10
B. Readiness-weighted (C1-heavy)	22	26	2	9/10
C. Cost-priority (C5-heavy)	10	38	2	2/10
D. Online-presence-priority (C3-heavy)	17	29	4	9/10
E. Transaction-priority (C4-heavy)	23	25	2	10/10

The ranking is materially sensitive to weight choice: 33 of the 50 MSMEs (66%) change maturity class under at least one of the four alternative schemes relative to the reported baseline, and the cost-priority scenario in particular reshuffles the top tier so severely that only 2 of the baseline top-10 MSMEs remain in the top-10 (Table 3b). The readiness- and transaction-priority scenarios are comparatively more stable (9/10 and 10/10 overlap), suggesting the baseline ranking is more sensitive to how much weight is placed on cost and online presence than on owner readiness or digital transactions specifically, though this pattern is observed on the current 50-record sample and is not claimed to generalize beyond it. This empirically confirms, rather than merely asserts, that the uniform placeholder weight materially shapes which MSMEs are classified as high-priority or high-maturity, and that eliciting definitive weights from stakeholders before using the ranking for assistance decisions (Section 4) is not a procedural formality but a substantive requirement: a materially different set of MSMEs would be flagged for assistance depending on which criterion stakeholders choose to emphasize. The full scenario-by-scenario class assignment for all 50 MSMEs is provided in Supplementary Material S2.

3.4. Functional and Security Testing Results

Black-box testing was conducted by the development team through both interface interaction and direct API calls to verify server-side rule enforcement; no independent or third-party tester was engaged, a scope limitation noted in the Method section. Two defects were found during initial development-team testing - the absence of duplicate-MSME detection and a page that failed to display an error message when access was denied - both of which were fixed and then re-verified in a separate regression run using an identical reproduction procedure; the totals in Table 4 report that post-fix regression run, so the 100% pass rate reflects successful correction rather than a first-pass quality metric.

Table 4. Recapitulation of post-fix regression testing

Testing category	Cases	Passed (post-fix)
Functional (black-box)	18	18 (100%)
Role-based access control	8	8 (100%)

Each of the 18 functional cases has a documented requirement ID, precondition, input, expected result, observed result, tester, environment, and status; this per-case log is reproduced in full in the Supplementary Material accompanying this submission, given the manuscript's page limit. Role-based access-control testing covered the eight scenarios in Table 5, verified down to the API response level:

an MSME-owner account received a null maturity-class value for every MSME other than its own, indicating that this specific field is filtered server-side rather than only concealed in the interface.

Table 5. Role-based access-control testing scenarios

Role	Scenario	Result
Surveyor	Admin-only menus hidden from the sidebar	Passed
Surveyor	Direct URL access to an admin-only page	Blocked, explicit message
Surveyor	Direct calls to admin-only API endpoints	403 Forbidden
Surveyor	Access to MSME data within surveyor authority	Passed
MSME owner	Own-business dashboard displays safely	Passed
MSME owner	Direct URL access to ranking/list pages	Blocked, explicit message
MSME owner	Map hides other MSMEs' maturity class	Passed, field-level null
MSME owner	Opening another MSME's detail page	403 Forbidden, explicit message

These eight scenarios assess object-level authorization for the maturity-class field and role-scoped page access only; they should not be characterized as comprehensive security testing. No formal threat model was developed, and the following were not tested in this study: authentication and session-management robustness beyond normal login, input validation and injection resistance, rate limiting, transport-layer security configuration, logging and audit-trail integrity, backup and recovery, and broader geolocation-privacy leakage beyond the maturity-class field. These are identified as required future work before any claim of comprehensive security assurance.

3.5. Preliminary User Feedback

A 15-item questionnaire covering perceived usefulness, ease of use [10], functional suitability, map-module usefulness, and recommendation usefulness was administered to a single respondent, a development-team administrator, who scored all items at the maximum value. A single respondent who participated in system development cannot yield interpretable evidence of user acceptance: the result is subject to self-assessment bias, provides no variance to assess response consistency, and does not constitute a substantive finding. It is reported here only as a preliminary data point, not as evidence of user acceptance, pending a properly powered study with an independent, adequately sized sample of administrators, surveyors, and MSME owners, including reported response scale, scoring, content validity, and reliability - none of which can be established from a single respondent.

3.6. Discussion

The results show that GIS, mobile-first application, and SAW-based DSS integration can be implemented on a single shared database so that ranking results can be visualized spatially without a separate record-linkage step, addressing the architectural gap identified in the reviewed literature, where GIS-based MSME mapping studies typically stop at visualization without producing a decision [3], [4]. The post-fix 100% pass rate on the tested functional and access-control cases indicates that those specific cases behave as specified after correction; it does not by itself establish general technical readiness, which would additionally require performance and concurrent-load testing, reliability and recovery testing, device and browser compatibility, responsive-layout verification, degraded-network behavior, accessibility testing, and independent usability evidence, none of which has yet been conducted. The compensatory property of SAW observed in this dataset - for example, the worked-example MSME attained its highest score partly through a perfect cost-criterion score offsetting a mid-range value on C3 - is a structural property of the additive model itself rather than an empirical discovery of this study. Its policy implication is that a severe weakness on one essential criterion can be fully offset by strengths elsewhere, which may be undesirable if a program requires a minimum standard on every criterion for eligibility; because this system's output may influence assistance allocation, whether a veto threshold, minimum-eligibility rule, or a non-compensatory ranking method such as those noted in the Introduction is needed should be decided with stakeholders before the ranking guides real allocation decisions, rather than assumed away by displaying per-criterion values alongside the aggregate score. The still-uniform, unelicited criteria weighting and thresholds remain the principal limitation of this study; all ranking

results should be read as a demonstration of system behavior, not a validated policy recommendation, until definitive weights and thresholds are established and sensitivity-tested with stakeholders.

4. CONCLUSION

This study designed, built, and tested a prototype mobile- and spatial-based information system that integrates a Geographic Information System, a mobile-first responsive web application, and a Simple Additive Weighting-based decision-support module for MSME digital-readiness assessment in Lubuklinggau City. Computational verification on 50 MSME records showed exact agreement between the system's preference values and an independent manual recalculation, and 18 functional test cases together with 8 role-based access-control scenarios passed in a post-fix regression run after two defects found during development-team testing were corrected. These results demonstrate that the software correctly implements the specified formulas and behaves as intended on the tested cases; they do not demonstrate improvement in MSME digital innovation, decision quality, program targeting, or user outcomes, and no causal or impact claim is made here pending a comparative field evaluation or longitudinal outcome study.

A specific technology-readiness-level rating is not asserted in this study: no formal TRL rubric was applied against documentary evidence, and the current provisional weights, single-respondent preliminary feedback, and untested performance, reliability, and independent-security dimensions would likely not satisfy a mid-range TRL claim if formally assessed. The system is, at this stage, more accurately described as a functionally verified prototype rather than a technically validated, deployment-ready decision tool. Several limitations should be addressed before the ranking output informs real assistance decisions: definitive criteria weights and class thresholds have not been elicited from stakeholders, and the sensitivity analysis reported above shows this matters substantively — 66% of MSMEs change maturity class under at least one of four alternative weight scenarios tested; the 50-record sample (about 0.51% of the city's 9,746 registered MSMEs, per the Method section) was collected purposively by two field surveyors without inter-rater reliability testing, and two of eight sub-districts were not yet reached; user-acceptance evidence currently consists of a single, non-independent respondent; and security testing was performed only by the development team against a narrow set of authorization scenarios, without a formal threat model or independent testing. Future work should prioritize, in roughly this order: eliciting definitive stakeholder weights and thresholds through a focus-group process and re-running the sensitivity analysis on that elicited configuration; an adequately powered, independent user-acceptance study across all three roles; independent or third-party security testing against a documented threat model; formal institutional ethics review and an itemized consent and data-retention protocol given the geolocation data involved; and extending field coverage to the remaining sub-districts with a longitudinal design to observe whether digital-maturity classes change following assistance.

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