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An Integrated Digital Maturity Index for Small Businesses: Development and Pilot Application to Pharmacy Retail in Uzbekistan

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Abstract: Digital infrastructure is expanding in Uzbekistan, creating a need to assess how small businesses use digital tools in their daily operations. This study develops an integrated index comprising twelve indicators in three blocks: infrastructure and access, processes and operations, and reported outcomes and fiscal digitalization. Weights are estimated using the analytic hierarchy process from forty pairwise comparison matrices obtained from ten experts through individual face-to-face interviews conducted from 20 to 30 May 2026. The index is applied to retrospective 2025 data from three pharmacy businesses employing five, six, and twelve people. Their index values are 0.348, 0.733, and 0.445, corresponding to basic, developed, and basic maturity. Two businesses have identical infrastructure scores, while their overall indices differ by 0.288 because of differences in operational use and reported outcomes. Equal block weights and six block-weight perturbations preserve the ranking and maturity levels. The pilot illustrates how the index identifies gaps between technical resources and their practical use, helping small businesses set priorities for digital development.

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1. Introduction

Digital transformation changes how organizations create and capture value through digital technologies [1]. In small businesses, it affects sales, payments, documentation, accounting, and management [2]. Financial resources, organizational capacity, and employee skills shape the adoption of these tools [3]. Assessing digital maturity therefore requires attention to both technical readiness and the use of digital solutions in everyday operations.

In Uzbekistan, the Digital Uzbekistan 2030 Strategy, approved by Presidential Decree No. UP-6079 of 5 October 2020, provides the national context for this development [4]. The National Statistics Committee reported that 94.2% of the population used the Internet in January–August 2025 [5]. Alongside expanding connectivity, the OECD identifies business awareness and digital skills as priorities for the Uzbek private sector [6]. These conditions call for an assessment that connects infrastructure, business processes, and operational changes.

Resource-based theory explains how organizational resources contribute to competitive advantage [7], while dynamic capabilities emphasize their reconfiguration [8]. Studies of strategic renewal [9] and industrial transformation [10] extend these

perspectives to digital technologies. Together, they provide a conceptual basis for distinguishing available digital resources from their application in business processes.

Digital maturity frameworks cover manufacturing capabilities [11], European businesses [12], and dimensions relevant to small and medium-sized enterprises [13]. Reviews also identify a need for clearer assessment criteria and empirical validation [14]. A framework for small businesses in Uzbekistan should accordingly use indicators suited to their operating scale and local business environment.

Research on micro-enterprises provides relevant assessment frameworks [15] and emphasizes strategy, processes, technology, and people in developing countries [16]. Multicriteria models for manufacturing SMEs [17], maturity-based transformation roadmaps [18], and an integrated model tested on 654 Brazilian enterprises [19] offer complementary approaches. Their common emphasis on context supports the development of a concise assessment for small businesses.

Regional research also addresses the digital development of SMEs. Kurbanova and colleagues examine digital transformation, human capital, and productivity among enterprises in Uzbekistan [20]. Yezhebay and colleagues develop a digital maturity and readiness model tailored to SMEs in Kazakhstan [21].

Studies link digitalization to business model innovation and performance [22] and examine its role in sustainable development [23]. The present assessment includes reported operational changes alongside infrastructure and processes. Following the OECD/JRC handbook, the indicator scales, weighting, aggregation, and sensitivity procedure are specified explicitly [24].

The objective of this study is to develop an integrated twelve-indicator index of digital maturity for small businesses in Uzbekistan and demonstrate its diagnostic application to three pharmacies.

2. Materials and Method

Data and participant selection

Two data components were used: pairwise comparisons from ten experts and completed questionnaires from three pharmacy businesses. Experts were selected purposively for professional competence, deep knowledge of the subject, and at least ten years of relevant experience (ten to forty years). The panel includes entrepreneurs, representatives of government and banking, and academic specialists, including two professors and one associate professor.

Individual face-to-face interviews were conducted between 20 and 30 May 2026. Oral judgments were entered into Excel during the interviews, and the initial responses were preserved. Each expert completed one 3×3 matrix comparing the blocks and three 4×4 matrices comparing indicators within blocks. This gives forty matrices and 210 independent pairwise entries, with 21 comparisons per expert.

After the purpose of the study was explained, oral consent to use responses in the author's research was obtained from experts and pharmacy representatives and recorded in a notebook. Enterprise results are reported under codes A, B, and C. The pharmacies were selected as small businesses on the basis of employee headcount and turnover. Business A is located in Pap and employs five people; B is in Tashkent and employs six; C is in Namangan Region and employs twelve.

Questionnaires were sent through Telegram in August–September 2026 and completed by one director at each pharmacy, using the same collection and coding procedure. Telephone calls clarified answers where needed, including customer locations. Respondents described the 2025 calendar year; for K₉ and K₁₁, they reported operational changes compared with 2–3 years earlier. Data collection was therefore retrospective. Reported changes covered work time, work volume, and monetary expenses.

Indicators and coding rules

The Integrated Digital Maturity Index (IDMI) for small businesses comprises three blocks: infrastructure and access (I_1), processes and operations (I_2), and reported outcomes and fiscal digitalization (I_3). Indicators K_1 – K_{12} receive scores of 0, 0.25, 0.50, 0.75, or 1.00, with higher scores indicating greater maturity. K_9 and K_{11} reflect reported operational changes, while the remaining indicators describe the level of digital practices in 2025. Table 1 presents the indicator structure and weights.

Table 1. Indicator structure and weights

Code	Indicator	Block	Local weight	Overall weight
K1	Functional Internet access for business	I1	0.290	0.072
K2	Connection speed and capacity	I1	0.272	0.067
K3	Working digital devices	I1	0.243	0.060
K4	Localized or adapted software	I1	0.195	0.048
K5	Payment integration with accounting	I2	0.297	0.122
K6	Active online presence	I2	0.246	0.101
K7	Revenue share from digital channels	I2	0.248	0.102
K8	Digital document workflows	I2	0.209	0.086
K9	Reported operational productivity gains	I3	0.343	0.117
K10	Market reach through digital channels	I3	0.281	0.096
K11	Reported operating cost reductions	I3	0.221	0.075
K12	Fiscal digitalization	I3	0.155	0.053

Source: the questionnaire coding rules and recalculation of the forty expert matrices. Overall weights equal block weights multiplied by local weights. Weights are displayed to three decimal places; calculations use full precision.

The questionnaire scales and maturity thresholds were set before the pharmacy data were collected. Each scale lists its five categories in ascending score order, from 0 to 1.00. Scores reflect the functions performed and the degree of integration between digital services. Fiscal data operators and electronic invoices are referred to below as FDOs and e-invoices.

K₁ Functional Internet access. Internet is practically unused in business processes; only unstable personal mobile connectivity is used; one intermittent working connection supports separate services; stable connectivity supports cash registers, banking, documents, or cloud services; primary and backup connections support uninterrupted key services.

K₂ Connection speed and capacity. Connectivity is unstable and insufficient for work; speed is below 10 Mbps; speed is at least 10 but below 30 Mbps, with limits on simultaneous use; speed is 30–100 Mbps inclusive and supports several devices and services; speed exceeds 100 Mbps or a stable business tariff is sufficient for working tasks.

K₃ Working devices. Devices are almost unused; only personal smartphones are used for communication; one or two devices support accounting, payments, orders, or documents; devices cover the main business functions; devices are systematically allocated across functions and regularly used with working software.

K₄ Adapted software. No software is used; simple spreadsheets, messengers, files, or unadapted solutions are used; one local application supports accounting, cash registers, inventory, or banking; two or three applications are adapted to taxation, payments, accounting, or the sector; comprehensive software connects cash registers, fiscal services, inventory, accounting, customer relationship management, or a sector-specific system.

K₅ Payment integration. Payments are mainly cash-based or recorded manually; separate cashless payments are not connected to accounting; a substantial cashless share requires manual reconciliation; more than 50% of payments are digital and regularly

reconciled with banking, cash register, or accounting records; payments are integrated with working systems. This indicator measures payment integration, while K₇ measures revenue generated through digital order channels.

K₆ Online presence. No online presence exists; a page, account, or map listing is rarely updated; updates and inquiries are irregular; active channels regularly generate inquiries; channels systematically generate requests, sales, reviews, repeat customers, or a sustained audience.

K₇ Digital revenue share. Less than 5%; at least 5% but below 15%; at least 15% but below 30%; 30–50% inclusive; more than 50%. Revenue refers to orders originating through digital channels during 2025.

K₈ Document workflows. Documents are mainly paper-based; some are handled in spreadsheets, messengers, or separate files; separate digital documents and services are used; most documents are digital but systems remain weakly connected; documents, cash registers, fiscal services, banking, and accounting form a single workflow.

K₉ Reported productivity changes. No effect on work speed or volume is reported; individual operations are faster; order, document, payment, or inventory processing takes less time; the same staff handle more orders, customers, or operations; operations scale without additional staff, with less manual work and faster service.

K₁₀ Market reach. Customers come from the immediate locality; some come from other districts of the city or settlement; customers come from different districts of the city or region; regular orders come from other regions of the country; sustained interregional or international digital sales occur.

K₁₁ Reported cost reductions. No reduction is observed; small operations become less costly with a limited overall effect; monetary expenses, time, paper use, manual accounting, or errors decrease noticeably; costs, errors, or time decrease by approximately 10–25%; costs decrease by more than 25% or major losses are eliminated. Both monetary expenses and time and work effort are considered.

K₁₂ Fiscal procedures. Procedures are manual or paper-based; one digital element is used; an online cash register with an FDO and separate electronic reporting are used; cash registers, fiscal services, banking, or accounting are used regularly with partial integration; cash registers, FDOs, e-invoices, banking, and accounting software operate in a common system.

The five-level scales use equal 0.25 increments for aggregation. The additive model allows stronger indicators to compensate partly for weaker ones, so block scores are reported alongside the total. Missing responses are not coded as zero. All twelve indicators were completed for each of the three pharmacies.

Expert weights and aggregation

Saaty's analytic hierarchy process (AHP) is applied [25], [26]. Each individual comparison matrix has positive entries, a unit diagonal, and reciprocal elements. Judgments use the 1–9 scale and its reciprocals, with 1 indicating equal importance.

All ten experts are assigned equal weight. Individual judgments are aggregated (AIJ) using the geometric mean of corresponding matrix entries [27]. For expert e and group G , the element is:

$$a_{ij}^{(G)} = \exp\left[\frac{1}{10} \sum_{e=1}^{10} \ln(a_{ij}^{(e)})\right] \quad (1)$$

The principal right eigenvector of each group matrix is obtained, and its positive elements are normalized to sum to one. Its entries serve as block weights α or local indicator weights β .

$$A^{(G)}w = \lambda_{\max}w; \quad w_i > 0; \quad \sum_i^n w_i = 1 \quad (2)$$

For every individual and group matrix, the consistency index CI and consistency ratio CR are calculated. Random indices of RI = 0.58 for $n = 3$ and RI = 0.90 for $n = 4$ are used, with $CR < 0.10$ as the consistency criterion [26].

$$CI = \frac{\lambda_{\max} - n}{n - 1}; \quad CR = \frac{CI}{RI} \quad (3)$$

Table 2. Consistency of group matrices

Comparison	n	$\lambda_{\max}$	CI	CR
Blocks I ₁ –I ₃	3	3.034	0.017	0.030
Indicators K ₁ –K ₄	4	4.034	0.011	0.013
Indicators K ₅ –K ₈	4	4.040	0.013	0.015
Indicators K ₉ –K ₁₂	4	4.035	0.012	0.013

Source: recalculation of the final forty-matrix dataset. CI denotes the consistency index; CR denotes the consistency ratio.

All forty individual matrices have CR below 0.10; the maximum is 0.069. Among the ten records in each comparison group, there are respectively two, four, two, and five distinct matrices. Because a 3×3 matrix contains three independent judgments and a 4×4 matrix six, and judgments are expressed on a discrete scale, identical matrices are expected when experts agree on the ordering of elements and use similar intensity values. Repeated matrices are retained as recorded, since each was obtained in a separate interview.

The block weights are $\alpha_1 = 0.247$, $\alpha_2 = 0.411$, and $\alpha_3 = 0.342$. For business r , block b , indicator j , and indicator set J_b , the block score and total are:

$$I_{rb} = \sum_{j \in J_b} \beta_{bj} k_{rj}; \quad IDMI_r = \sum_{b=1}^3 \alpha_b I_{rb} \quad (4)$$

The sets are $J_1 = \{1, 2, 3, 4\}$, $J_2 = \{5, 6, 7, 8\}$, and $J_3 = \{9, 10, 11, 12\}$. Because local weights sum to one within each block, all block scores and totals lie in $[0, 1]$. The same total is obtained by summing the twelve indicator scores multiplied by their overall weights (Table 1); this equivalence served as an arithmetic check.

Maturity intervals and sensitivity

Four nonoverlapping intervals are used to interpret digital maturity (Table 3). The thresholds were specified before pharmacy data collection. Classification is based on the unrounded total, followed by rounding for display.

Table 3. Working maturity intervals

IDMI interval	Level
$0 \leq \text{index} < 0.26$	Initial
$0.26 \leq \text{index} < 0.51$	Basic
$0.51 \leq \text{index} < 0.76$	Developed
$0.76 \leq \text{index} \leq 1$	Advanced

Source: the proposed descriptive classification.

Eight weighting scenarios are examined: the baseline, exact equal block weights of $1/3$, and six block-weight perturbations. In each perturbation, one block weight is increased or decreased by 0.05, and each remaining weight is adjusted by 0.025 in the opposite direction. All weights remain positive and sum to one. Indicator scores and local weights are held fixed [24].

Business rankings, score ranges, and crossings of maturity thresholds are compared using unrounded block scores. The analysis is descriptive, and statistical significance tests are not applied.

3. Results

The process and operations block receives the largest weight, 0.411, followed by reported outcomes and fiscal digitalization, 0.342, and infrastructure and access, 0.247. K₅, payment integration, and K₉, reported productivity changes, receive the largest overall indicator weights.

Table 4 presents the indicator scores for the three pharmacies. Businesses B and C have identical infrastructure profiles, while their operational and outcome scores differ. Business A has lower infrastructure scores than the other two cases.

Table 4. Indicator scores for the 2025 reporting period

Indicator	Business A	Business B	Business C
K1	0.75	1.00	1.00
K2	0.50	0.75	0.75
K3	0.75	1.00	1.00
K4	0.50	1.00	1.00
K5	0.50	1.00	0.75
K6	0.00	0.75	0.00
K7	0.00	0.50	0.00
K8	0.50	1.00	0.75
K9	0.25	0.25	0.00
K10	0.00	0.50	0.00
K11	0.25	0.50	0.25
K12	0.75	1.00	0.75

Source: the completed questionnaires and telephone clarifications. A: Pap, 5 employees; B: Tashkent, 6 employees; C: Namangan Region, 12 employees.

Table 5. Block scores and integrated index

Business	I ₁	I ₂	I ₃	IDMI	Level
A	0.633	0.253	0.257	0.348	Basic
B	0.932	0.815	0.492	0.733	Developed
C	0.932	0.380	0.171	0.445	Basic

Source: calculations from Table 4 using full-precision weights. Scores and differences are calculated before rounding to three decimal places.

Business A is classified at the basic level. It uses digital tools in its main functions and fiscal procedures, with partial integration between services. Its weaker items concern online presence, digital-channel revenue, and market reach. The director reported faster individual operations and lower expenses for some operations, corresponding to $K_9 = K_{11} = 0.25$.

Business B is classified at the developed level. Payment integration, document workflows, and fiscal procedures receive maximum scores. $K_7 = 0.50$ corresponds to digital-channel revenue of at least 15% but below 30%. Faster individual operations and noticeable reductions in operational costs and effort are reported. Its process profile is stronger than its reported outcome profile.

Business C is classified at the basic level. Strong device and software scores coexist with no online presence, digital-channel revenue below 5%, and no reported productivity improvement. Fiscal services are used regularly with partial integration. This combination produces a lower total than B despite equal infrastructure scores.

The B–C comparison shows how the index distinguishes businesses with similar technical resources. Their totals differ by 0.288. The difference in I_2 is 0.435 and in I_3 is 0.320. At baseline weights, the process block contributes 0.179 to the total gap and the outcome/fiscal block contributes 0.109; the infrastructure contribution is zero. Approximately 62% of the gap is associated with the process block.

Table 6. Sensitivity to block weights

Scenario	α_1	α_2	α_3	A	B	C
Baseline	0.247	0.411	0.342	0.348	0.733	0.445
Equal	0.333	0.333	0.333	0.381	0.746	0.494
$\alpha_1 + 0.05$	0.297	0.386	0.317	0.367	0.747	0.478
$\alpha_1 - 0.05$	0.197	0.436	0.367	0.330	0.719	0.412
$\alpha_2 + 0.05$	0.222	0.461	0.317	0.339	0.738	0.436
$\alpha_2 - 0.05$	0.272	0.361	0.367	0.358	0.728	0.454

$\alpha_3 + 0.05$	0.222	0.386	0.392	0.339	0.714	0.421
$\alpha_3 - 0.05$	0.272	0.436	0.292	0.358	0.752	0.469

Source: calculations. Equal weights are exactly 1/3. A ± 0.05 change in one block is offset by ∓ 0.025 in each other block; indicator scores and local weights remain fixed.

The ranking $B > C > A$ remains unchanged in all eight scenarios. A ranges from 0.330 to 0.381; B from 0.714 to 0.752; and C from 0.412 to 0.494. A and C remain at the basic level, while B remains developed. The smallest B–C gap is 0.252.

4. Discussion

The central finding is that a similar infrastructure base can support different levels of digital maturity. The distinction between digital resources and their organizational application follows the dynamic capability perspective [9], [10]. In the pharmacy cases, the operational use of available tools explains the separation between profiles within the index. This makes the assessment useful for identifying the business functions that require attention.

The IDMI translates a multidimensional assessment into twelve indicators that can be discussed with a small-business manager. The roadmap model of Mick and colleagues covers 75 processes across six dimensions [18]. In Central Asia, Yezhebay and colleagues propose six dimensions and fifteen sub-dimensions for assessing SME digital maturity and readiness in Kazakhstan [21]. Broader SME and micro-enterprise frameworks also include strategy and employee capabilities [13], [16]. The present index focuses on infrastructure, operating routines, reported changes, and fiscal integration, providing a concise starting point for planning digital development.

The profiles suggest different practical priorities. For A, connecting payments, documentation, and accounting can complement its existing digital tools, while an active online channel can support customer communication. For C, the immediate priority is to use its infrastructure more actively in customer-facing processes and digital sales. For B, attention can shift toward tracking processing time, errors, expenses, and repeat orders to evaluate how integrated systems perform. The value of the index lies in tailoring these priorities to the business profile.

The OECD review identifies business awareness and digital skills as priorities for Uzbekistan [6]. Kurbanova and colleagues jointly examine digital transformation, human capital, and productivity among Uzbek SMEs [20]. These perspectives support attention to the use of technology alongside its availability. For business-support organizations, the three blocks provide a structure for an initial assessment and a discussion of training and implementation needs.

The pilot has several limitations. It covers three pharmacies, so the results illustrate the procedure rather than characterize the sector. Each profile relies on a single director's retrospective self-report, and K_9 and K_{11} depend on recalled comparisons with 2–3 years earlier. Because these two indicators measure change rather than level, a business that digitalized earlier may receive lower scores on them. The five-level ordinal scales are aggregated as equal-interval scores, and the maturity thresholds are working conventions not yet validated against external performance measures. Sector-specific conditions, such as the predominantly local customer base of pharmacies and the regulation of medicine sales, may also constrain K_6 , K_7 , and K_{10} independently of digital maturity.

For subsequent applications, the same reporting period and scoring rules should be maintained so that changes in block profiles can be compared over time. Extending the assessment to other service and retail businesses would help evaluate its usefulness across operating contexts.

5. Conclusion

This study developed an integrated twelve-indicator index for assessing the digital maturity of small businesses in Uzbekistan and applied it to three pharmacies. Forty matrices from ten experts yield block weights of 0.247, 0.411, and 0.342, with group consistency ratios between 0.013 and 0.030.

The integrated scores of 0.348, 0.733, and 0.445 classify A and C at the basic level and B at the developed level. B and C share an infrastructure score of 0.932, while their overall indices differ by 0.288 through the other two blocks. The ranking and maturity levels remain stable under equal weights and six block-weight perturbations. The index provides a practical basis for distinguishing technical readiness from operational use and setting priorities for further digital development.

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