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Digital Labor Adaptability and Mahalla-Based Youth Employment Governance in Uzbekistan: A Conceptual Framework

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Abstract: This study develops an operational concept of digital labor adaptability and embeds it in a mahalla-based digital governance model for sustainable youth employment in Uzbekistan. The empirical component uses annual national indicators for 2020-2025 and exploratory Pearson correlations to examine whether the expansion of digital access and digital-sector employment has been accompanied by improved youth labor-market outcomes. Internet use increased from 71.1 to 90.0 users per 100 people, employment in information and communication rose from 62.2 to 110.5 thousand, and registered self-employment expanded from 0.1 to 4.4 million persons. However, youth unemployment declined only from 12.8% to 11.4%, with an increase in 2025, while estimated informal employment decreased from 40.0% to 38.0%. Youth unemployment was strongly associated with the overall employment-to-population ratio ($r = -0.979$, $P < 0.01$) and internet use ($r = -0.879$, $P < 0.05$), although the six-year series does not permit causal inference. The proposed model integrates a unified digital youth profile, risk classification, assessment of digital labor adaptability, individual pathway assignment, coordinated employment and entrepreneurship services, and outcome monitoring after 3, 6, and 12 months. Its performance is evaluated through formal employment, income growth, skill matching, retention, and business survival rather than program participation alone. The model provides a practical architecture for linking national digital infrastructure with local last-mile institutions and for shifting youth policy from administrative coverage to sustainable labor-market outcomes. The article proposes a five-domain measurement blueprint for digital labor adaptability; individual scores are not calculated because harmonized youth microdata are not yet available.

Keywords: youth employment; digital labor adaptability; mahalla; labor-market governance; Uzbekistan

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1. Introduction

Youth labor markets combine economic opportunity with structural vulnerability. Young people are more likely than prime-age workers to lack work experience, professional networks, verified skills, and access to stable first jobs. International evidence therefore treats the transition from education to work as a sequence that includes career guidance, practical training, matching, first-job support, income security, and retention rather than a single placement event. The International Labour Organization emphasizes that youth unemployment remains substantially above adult unemployment and that young people outside employment, education, or training represent a major loss of human

capital. The Organisation for Economic Co-operation and Development similarly recommends a whole-of-government youth policy that connects education, employment, entrepreneurship, social inclusion, and public governance [1].

The problem is particularly important in Uzbekistan. The country has a young and growing population, large annual cohorts entering the labor market, substantial regional differences in employment opportunities, and a persistent gap between formal qualifications and employer demand. Earlier World Bank research identified limited work experience, insufficient practical skills, weak access to startup capital, and the scarcity of quality jobs as major constraints on youth employment and entrepreneurship. At the same time, technological change is transforming the content of jobs. The World Economic Forum expects rapid reallocation of tasks and strong demand for reskilling by 2030, while research on automation and artificial intelligence shows that employment effects depend on whether technology substitutes for routine tasks or complements workers' analytical, interpersonal, and problem-solving capabilities [2].

Digitalization also creates new employment institutions. Online job search, remote work, platform-mediated services, electronic commerce, digital finance, and startup ecosystems can lower entry barriers for young workers.²¹ Yet these channels may produce unstable incomes, algorithmic control, weak social protection, and new forms of inequality when access to devices is not matched by occupational skills and bargaining power. The policy challenge is therefore not merely to increase internet connectivity, but to convert digital access into sustainable employment, formal income, and professional development [3].

This article introduces the category of digital labor adaptability, defined as a young person's capacity to acquire, update, and apply digital skills in occupational tasks; navigate digital labor-market institutions; combine digital and non-digital competencies; and transform these capabilities into sustainable employment, income, or entrepreneurship. The concept extends digital literacy by focusing on labor-market outcomes and adaptation over time. It also responds to the institutional specificity of Uzbekistan, where the mahalla - a neighborhood-level self-governance institution - can function as a last-mile mechanism for identifying risk, coordinating services, and following individual employment trajectories [4].

The objective of this study is to develop and analytically substantiate a mahalla-based digital governance model that converts digital labor adaptability into sustainable youth employment outcomes in Uzbekistan [5].

2. Materials and Methods

Research design and data

The study uses a mixed methodological design combining structural-dynamic analysis, exploratory correlation analysis, institutional analysis, and organizational-economic modeling. The empirical dataset covers 2020-2025 and was compiled in the underlying DSc dissertation from official publications of the National Statistics Committee of the Republic of Uzbekistan, labor-market administrative reports, World Bank modeled estimates, and sectoral digital-economy statistics.¹³⁻¹⁵ The variables include youth unemployment among persons aged 15-24, the employment-to-population ratio for persons aged 15 years and older, internet users per 100 population, average monthly nominal wages, employment in information and communication, registered self-employment, and the estimated informal-employment share.

The indicators use different age bases because a complete, harmonized annual youth panel is not publicly available for all dimensions. The employment-to-population ratio and informal-employment share are therefore used as contextual labor-market indicators rather than direct youth-specific outcomes. Nominal wage and registered self-employment figures are also interpreted cautiously: wage growth is not adjusted for inflation, and the rapid increase in self-employment partly reflects administrative formalization and registration reforms.

Age scope. The operational governance model addresses Uzbekistan's broader national youth-policy population aged 14-30 years. The empirical youth-unemployment series is limited to ages 15-24 because this is the internationally comparable annual indicator available for 2020-2025. Employment, wage, self-employment, information-and-communication employment, and informality indicators refer to the total working-age or employed population and are used only as contextual structural variables; they are not interpreted as youth-specific measures.

Exploratory statistical procedure

Pearson correlation coefficients were calculated between youth unemployment and each structural indicator using six annual observations. Tests were two-tailed, with statistical significance identified as $*P<0.05$ and $**P<0.01$ in accordance with the journal's reporting convention. Calculations were performed in Python 3.13.5 using SciPy 1.17.0. Given the very small sample, the results are treated as descriptive evidence of co-movement rather than causal estimates. No multivariate regression was reported because six national observations would generate unstable and potentially misleading coefficients. A future validation stage should use a region-year panel covering 14 territorial units and multiple years.

Robustness checks comprised Spearman rank correlations, Pearson correlations in first differences, and leave-one-year-out recalculation of the level correlations. These checks assess sensitivity to rank ordering, common linear trends, and individual annual observations; they do not overcome the fundamental limitations of a six-observation national time series.

Conceptualization of digital labor adaptability

Digital labor adaptability is operationalized through five domains: foundational digital access and literacy; applied occupational digital skills; capacity for continuous learning and reskilling; ability to navigate electronic vacancies, platforms, digital contracts, and public services; and capacity to generate formal and sustainable income through digitally enabled employment or entrepreneurship. The concept is intentionally outcome-oriented. A person may have internet access and basic device skills but still display low digital labor adaptability if he or she cannot meet employer requirements, verify competencies, secure stable income, or update skills when technology changes. This approach is consistent with human-capital and task-based theories, which emphasize that the economic return to education depends on the productive use of skills within changing occupational tasks.^{5,6,10}

Table 3. Proposed measurement blueprint for the Digital Labor Adaptability Index

Domain	Illustrative indicator set	Proposed measurement
Foundational digital access and literacy	Reliable device and internet access; basic information, communication, security, and transaction tasks.	Standardized assessment and verified access indicators, converted to a 0-100 score.
Applied occupational digital skills	Use of occupation-specific software, digital equipment, data tools, e-commerce, or platform applications.	Practical task test, portfolio, certificate, internship, or employer verification, scored 0-100.
Continuous learning and reskilling capacity	Recent training, completion behavior, learning readiness, and ability to transfer skills across tasks.	Training records and structured assessment, scored 0-100.

Digital labor-market navigation	Use of e-vacancies, digital public services, e-contracts, online portfolios, and safe platform practices.	Verified platform and service use plus digital-rights knowledge, scored 0-100.
Sustainable digitally enabled outcome	Formal employment or registered business, income adequacy, skill use, and retention at 3, 6, and 12 months.	Administrative and follow-up outcome records, scored 0-100.

Provisional aggregation: $DLAi = 0.20(Ai + Oi + Li + Ni + Si)$, where the five domain scores range from 0 to 100. Equal weights are provisional and should be validated through expert assessment, internal-consistency testing, and predictive validity against formal employment, income, and retention outcomes.

Institutional model development

The mahalla-based platform model was developed through functional mapping of the institutions that shape youth trajectories: mahallas and youth leaders, schools and professional education organizations, universities and career centers, employment services, employers, banks, tax institutions, business incubators, and digital labor platforms. The design follows three principles. First, fragmented administrative records are converted into a consent-based digital youth profile. Second, support is assigned according to individual risk and potential rather than broad demographic categories. Third, success is evaluated after 3, 6, and 12 months through employment status, formality, income, retention, skill use, and business survival. Uzbekistan's recent labor-relations, professional-training, youth-entrepreneurship, and youth-employment reforms provide an institutional basis for this approach.¹⁶⁻¹⁸

Ethical considerations

The study used aggregated national indicators and conceptual institutional modeling. It did not involve human participants, personal records, clinical information, or identifiable microdata. Ethical approval and informed consent were therefore not applicable. The proposed operational platform, however, requires explicit user consent, purpose limitation, role-based access, data minimization, encryption, and an auditable record of data use.

3. Result and Discussion

Results

Digital expansion and persistent youth labor-market pressure

Uzbekistan experienced rapid digital and economic transformation during 2020-2025, but improvements in digital access did not translate automatically into a proportionate reduction in youth unemployment. Table 1 shows that internet use increased by 18.9 percentage points and employment in information and communication rose by 77.7%. Registered self-employment expanded more than fortyfold from a low starting base. Over the same period, youth unemployment decreased by only 1.4 percentage points and rose from 10.8% in 2024 to 11.4% in 2025. Estimated informal employment fell by 2.0 percentage points but remained high [6, 7].

Table 1. Selected indicators of digitalization and labor-market conditions in Uzbekistan, 2020-2025

Indicator	2020	2021	2022	2023	2024	2025
Youth unemployment, ages 15-24, %	12.8	13.0	10.9	10.8	10.8	11.4
Employment-to-population ratio, ages 15+, %	52.6	53.0	55.1	55.2	55.1	54.8

Indicator	2020	2021	2022	2023	2024	2025
Internet users per 100 population	71.1	76.6	83.9	89.0	89.5	90.0
Average monthly nominal wage, million UZS	2.7	3.2	3.9	4.6	5.4	6.4
Employment in information and communication, thousand	62.2	69.8	78.3	87.8	98.5	110.5
Registered self-employed, million persons	0.1	0.6	1.2	1.8	2.5	4.4
Estimated informal-employment share, %	40.0	41.0	39.5	39.0	38.8	38.0

Note: Youth unemployment is the World Bank/ILO modeled estimate for ages 15-24. Wage values are nominal. Registered self-employment reflects both economic activity and administrative formalization. The informal-employment row is a dissertation-based harmonized estimate derived from labor-force and administrative materials and is not an official annual youth series. Sources: National Statistics Committee annual labor-market, wage, self-employment, and information-and-communication releases; World Bank indicators; author's calculations.

The pattern supports a distinction between digital access and digital labor adaptability. Internet connectivity can improve access to vacancies, courses, public services, and markets, but the labor-market return depends on applied skills, work experience, occupational matching, employer demand, and the quality of the employment relationship. The persistence of informality also means that a digital or platform-mediated income source cannot be assumed to be stable or socially protected [8].

Exploratory associations with youth unemployment

Table 2 presents exploratory correlations. The employment-to-population ratio had a very strong inverse relationship with youth unemployment ($r = -0.979$, $P < 0.01$), indicating that years of broader labor-market activation were also years of lower youth unemployment. Internet use was negatively correlated with youth unemployment ($r = -0.879$, $P < 0.05$). Employment in information and communication, nominal wages, and registered self-employment also had negative coefficients, but they were not statistically significant in the six-year series. Informal employment had a positive coefficient ($r = 0.748$), but the association was not statistically significant at the 5% level ($P = 0.087$).

Table 2. Exploratory correlation of structural indicators with youth unemployment, 2020-2025 [9].

Structural indicator	Pearson r	P value	Interpretation
Employment-to-population ratio, ages 15+	-0.979**	0.001	Broad labor-market activation is closely associated with lower youth unemployment.
Internet users per 100 population	-0.879*	0.021	Digital access may improve information, learning, matching, and income opportunities.
Average monthly nominal wage	-0.668	0.147	Higher wages co-move with lower youth unemployment, but the short series is inconclusive.

Structural indicator	Pearson r	P value	Interpretation
Employment in information and communication	-0.672	0.143	Digital-sector expansion is directionally favorable but requires applied skills.
Registered self-employment	-0.555	0.253	Self-employment can absorb labor, but income stability and formality must be verified.
Estimated informal-employment share	0.748	0.087	Positive coefficient, but not statistically significant at the 5% level.

Note: n = 6 annual observations; two-tailed tests. *P<0.05; **P<0.01. Correlations are exploratory and do not imply causality.

Sensitivity analysis confirmed that the employment-to-population association was comparatively stable: Spearman's rho = -0.897 (P = 0.015), the first-difference correlation was r = -0.963 (P = 0.009), and leave-one-year-out Pearson coefficients ranged from -0.993 to -0.976. The internet association was less robust: Spearman's rho = -0.580 (P = 0.228), the first-difference correlation was r = -0.700 (P = 0.188), and leave-one-year-out coefficients ranged from -0.924 to -0.837. The level correlation with internet use may therefore partly reflect common time trends [10].

These associations do not establish that connectivity causes lower youth unemployment. The variables share strong time trends, and the observation count is too small for robust causal modeling. Their value lies in demonstrating the analytical gap: digital expansion appears relevant, but a governance system is required to identify which young people can convert digital access into skills, matching, formal work, or sustainable entrepreneurship [11].

Architecture of the platform-mahalla governance model

The proposed model treats the mahalla as a local diagnostic and coordination node rather than as a stand-alone employment provider. Its function is to identify young people whose labor-market risks are not visible in aggregate statistics, update their profile, and connect them to specialized institutions. The digital platform integrates this local information with education records, verified competencies, vacancies, internship opportunities, employer requirements, financial support, tax status, and program participation [12].

Table 4. Functional architecture and performance metrics of the platform-mahalla model

Functional block	Core information or action	Principal institutions	Outcome metrics
Digital profile and risk diagnosis	Education, skills, employment status, household constraints, professional interests, digital access, and entrepreneurial intention.	Mahalla, youth services, schools, colleges, universities, employment services.	Updated profile coverage; identified risk category; completion of digital labor adaptability assessment.
Skills and pathway assignment	Skill gaps, occupational preferences, vacancy requirements, training options, mobility	Career centers, professional education providers, employers,	Individual pathway coverage; training

Functional block	Core information or action	Principal institutions	Outcome metrics
	constraints, and appropriate employment or business pathway.	employment services.	completion; verified competencies; skill-to-vacancy match.
First job and employer matching	Vacancies, internships, wage and contract conditions, mentorship, probation, and first-job support.	Employers, employment services, chambers and educational organizations.	Placement within 3 months; formal contract; starting wage; retention after 6 and 12 months.
Entrepreneurship and digitally enabled work	Business idea, finance, incubation, acceleration, digital sales, platform work, registration, and tax activity.	Youth agency, banks, funds, business incubators, IT Park, tax authorities.	Business registration; income; project survival; jobs created; transition from necessity self-employment.
Monitoring and policy feedback	Employment, formality, income, retention, training use, employer feedback, and repeated risk after 3, 6, and 12 months.	Mahalla, labor and tax authorities, statistical bodies, regional administrations, employers.	Sustainable employment; income growth; lower repeat unemployment; program cost per durable outcome.

Note: The architecture is a proposed governance model. Outcome indicators should be disaggregated by sex, age group, disability status, region, and urban-rural location.

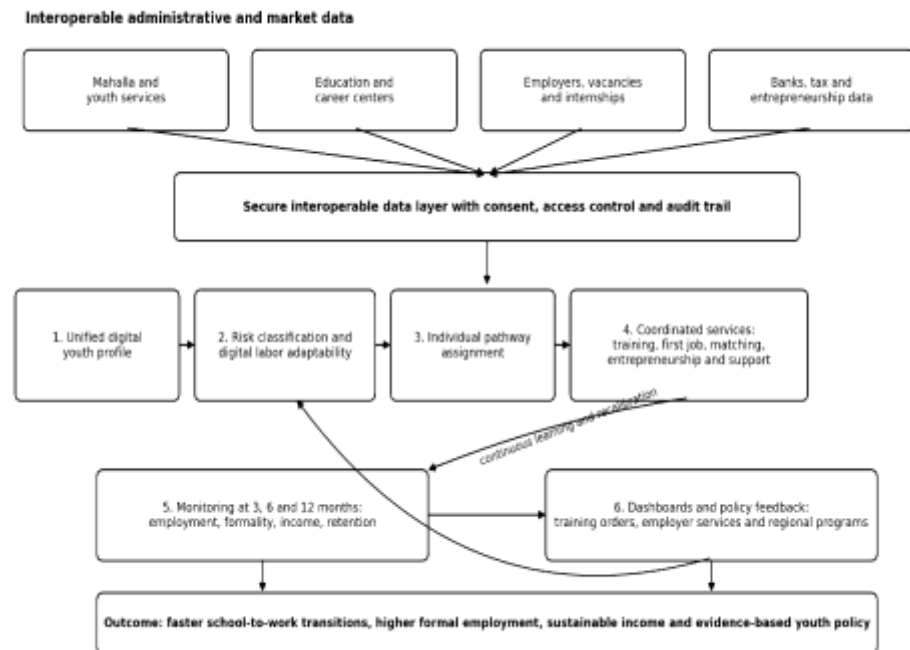


Figure 1. Integrated digital platform-mahalla cycle for sustainable youth employment

Figure 1 shows the governance cycle. Four data groups feed a secure interoperable layer. A unified profile is then used for risk classification and the assessment of digital labor adaptability. The system assigns a pathway rather than a generic service package. Coordinated interventions can include training, reskilling, first-job placement, employer matching, entrepreneurship, and social or mobility support. Monitoring after 3, 6, and 12 months closes the feedback loop by updating training orders, employer services, and regional programs [13].

The central management innovation is the change in the unit of performance. Existing programs often count registrations, consultations, training places, loans, or initial placements. The proposed model counts durable outcomes: a formal contract or registered activity, income growth, employment retention, correspondence between skills and work, and business survival. This reduces incentives for formal reporting and makes program evaluation more closely aligned with the economic welfare of young people [14].

Discussion

The results support a layered interpretation of digitalization. Uzbekistan has achieved rapid growth in connectivity, digital services, and employment in information and communication. These changes expand the opportunity set available to young people. However, the limited reduction in youth unemployment and the persistence of informality show that infrastructure is a necessary but insufficient condition. The mechanism connecting connectivity to employment includes practical skills, recognized competence, employer demand, first-job experience, institutional matching, and the capacity to adapt when tasks change. The observed association between internet use and youth unemployment should not be interpreted as a direct employment effect, because both variables contain pronounced time trends and the rank- and difference-based robustness checks are not statistically significant [15].

This interpretation is consistent with task-based research. Automation and artificial intelligence do not affect all workers equally; they alter the composition of tasks and reward workers who can combine technical tools with judgment, communication, and domain knowledge.⁵⁻⁷ Digital labor adaptability therefore differs from narrow computer literacy. It is a dynamic capability that includes learning how to learn, transferring skills

between occupations, verifying competence, and maintaining income when technologies or platforms change [16].

The model also addresses information asymmetry. Employers often cannot observe the practical capabilities of inexperienced applicants, while young jobseekers may not understand occupational requirements, wage conditions, or career prospects. A verified digital profile can reduce this gap, but only when it is linked to evidence such as portfolios, certificates, internships, employer feedback, and employment outcomes [17]. Otherwise, the platform risks becoming another administrative registry.

The mahalla contributes a distinct institutional function. International youth-employment systems often rely on national employment services, educational institutions, and employer platforms. In Uzbekistan, the mahalla can add localized knowledge about family constraints, transport, care responsibilities, informal activity, professional interests, and social risk. This last-mile information is especially important for young people outside education, employment, or training, young women with care responsibilities, rural youth, persons with disabilities, and returned migrants. UNICEF and UNDP assessments similarly emphasize that youth transitions and inclusive labor-market services require coordinated, person-centered support rather than isolated interventions [18].

At the same time, localization must not produce excessive discretion or stigmatization. Risk classification should be transparent, contestable, and used to expand opportunities rather than restrict them. Algorithms must not infer employability from poverty status, gender, disability, or place of residence. Human review is necessary when automated recommendations affect access to training, finance, or jobs. Data protection is not a technical afterthought; it is a condition of trust and participation [19].

Implementation should proceed in stages. The first stage is data governance: a common data dictionary, legal basis for exchange, consent protocols, access rules, and an audit trail. The second stage is a limited pilot in regions with different labor-market structures. The third stage is prospective evaluation using matched comparison groups or phased rollout, with indicators measured at baseline and after 3, 6, and 12 months. The fourth stage links program finance to durable results, while avoiding incentives to exclude young people with greater barriers. The fifth stage uses regional dashboards to adjust educational enrollment, short-course provision, internship quotas, and entrepreneurship support [20].

The proposed approach complements recent reforms. Measures to modernize labor relations and professional training can provide digital documentation and employer participation; youth-entrepreneurship instruments can support incubation, acceleration, and financing; and the 2026-2027 youth employment agenda can provide a framework for regional implementation. Research in Uzbekistan also highlights the need to integrate human-capital development, artificial intelligence, modern human-resource management, and new forms of employment into labor policy. The platform-mahalla model translates these broad priorities into an observable individual trajectory [21].

Several limitations should be acknowledged. The national annual series is short and contains variables with different age definitions. Pearson correlations remain vulnerable to common trends and omitted variables; the supplementary rank, first-difference, and leave-one-year-out checks improve transparency but do not establish causality. The article proposes a five-domain measurement blueprint but does not calculate individual digital labor adaptability scores because harmonized microdata are not available. The institutional model is therefore a testable conceptual design rather than a completed impact evaluation [22]. Future research should use a region-year panel, vacancy text, graduate tracking, employer surveys, tax and employment records, and longitudinal youth data. It should validate the proposed scale, compare alternative weighting and classification methods, and test whether the model improves outcomes relative to existing services.

4. Conclusion

The study developed a labor-market-oriented concept and a five-domain measurement blueprint for digital labor adaptability and embedded them in a mahalla-based digital governance model for youth employment in Uzbekistan. The 2020-2025 evidence shows a clear asymmetry: digital access and digital-sector employment expanded rapidly, while youth unemployment and informal employment remained persistent. Broader employment absorption is consistently associated with lower youth unemployment, whereas the internet-use association is sensitive to trend-robustness checks and cannot be interpreted causally. The main implication is institutional. Digitalization generates sustainable youth employment only when access is connected to verified skills, individual pathways, employers, first-job experience, entrepreneurship support, formalization, and follow-up. A platform-mahalla model can create this connection by combining national data infrastructure with local diagnosis and by evaluating outcomes after 3, 6, and 12 months. Its practical purpose is to move youth policy from counting program participants to managing durable employment, formal income, skill utilization, and business survival.

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Conflict of Interest

The author declares no conflict of interest.

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Data Availability

The complete six-year analytical dataset, variable definitions, source notes, and reproducibility code for Pearson, Spearman, first-difference, and leave-one-year-out calculations are provided as Supplementary Data File 1 and Supplementary Code File 1 in the submission package. The proposed individual platform requires consent-based administrative microdata that are not currently available as a harmonized public longitudinal dataset.

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