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A SYSTEMS-BASED QUANTITATIVE AND STRUCTURAL EQUATION MODELING FRAMEWORK FOR INVESTIGATING JOB SATISFACTION AMONG IT PROFESSIONALS IN URGENCH, UZBEKISTAN

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Annotatsiya. Ushbu maqola O‘zbekistonning Urganch shahridagi axborot texnologiyalari (IT) mutaxassislari orasida mehnat qoniqishini belgilovchi omillarni o‘rganish uchun tizimli yondashuv asosida ishlab chiqilgan miqdoriy so‘rov va strukturaviy tenglamalar modeli (SEM) doirasini taqdim etadi. Tadqiqot ish haqi qoniqishi, karyera rivojlanishi, mehnat muxtoriyati, rahbarlik yordami va tashkiliy muhitni mustaqil o‘zgaruvchilar sifatida aniqlaydi. So‘rovnoma dizayni, ma’lumotlarni oldindan qayta ishlash va regressiya hamda SEM usullarini qo‘llagan holda natijalarni tahlil qilish bo‘yicha batafsil reja taqdim etiladi. Tadqiqot natijalari mintaqadagi IT tashkilotlari uchun amaliy ahamiyatga ega bo‘lishi va kelajakdagi empirik tadqiqotlar uchun metodologik asos bo‘lib xizmat qilishi kutilmoqda.

Kalit so‘zlar: Mehnat qoniqishi; IT mutaxassislari; So’rov metodologiyasi; Strukturaviy tenglamalar modellashtirish; Regressiya tahlili; Ijtimoiy-texnik tizimlar; Karyera rivojlanishi; Ish muxtoriyati; Rahbarlik yordami; Mintaqaviy IT ekotizimi.

Аннотация. Данная статья представляет комплексную количественную и структурную методологию для изучения детерминант удовлетворённости трудом среди ИТ-специалистов в Ургенче, Узбекистан. Исследование идентифицирует удовлетворённость заработной платой, развитие карьеры, автономию труда, поддержку руководства и организационную среду как ключевые предикторы. Подробно описываются дизайн опроса, методы предварительной обработки данных и план статистического анализа.

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Ключевые слова: Удовлетворённость трудом; ИТ-специалисты; Методология опроса; SEM; Множественный регрессионный анализ; Развитие карьеры; Автономия труда; Организационная среда; Минтака.

Abstract. This paper presents a survey-based quantitative and Structural Equation Modeling (SEM) framework for investigating the determinants of job satisfaction among information technology (IT) professionals in Urgench, Uzbekistan. The study identifies salary satisfaction, career development, job autonomy, leadership support, and organizational environment as key independent variables influencing overall job satisfaction. A comprehensive cross-sectional survey instrument is designed using validated multi-item Likert scales. The paper details the survey methodology, sampling strategy, data preprocessing procedures, and a planned analytical pipeline encompassing descriptive statistics, correlation analysis, multiple regression, and two-stage SEM. By framing job satisfaction as a measurable socio-technical system output, the study contributes a rigorous methodological blueprint for empirical IT workforce research in emerging regional technology ecosystems. The findings are expected to provide actionable insights for regional IT organizations and serve as a foundation for future data-driven organizational interventions.

Keywords: Job Satisfaction; IT Professionals; Survey Methodology; Structural Equation Modeling (SEM); Multiple Regression Analysis; Socio-Technical Systems; Career Development; Job Autonomy; Leadership Support; Organizational Environment; Regional IT Ecosystem; Uzbekistan; Quantitative Research; Workforce Analytics; Human Factors.

INTRODUCTION

The global information technology (IT) sector has emerged as one of the most dynamic and competitive labour markets of the twenty-first century. Unlike traditional manufacturing industries, IT enterprises depend almost exclusively on the intellectual output, creativity, and sustained motivation of their human workforce. Within this context, job satisfaction has transitioned from a purely psychological concept into a measurable performance indicator with direct implications for organizational productivity, software quality, innovation capacity, and employee retention [Hackman & Oldham, 1976; Locke, 1976; Spector, 1997].

Uzbekistan has experienced significant growth in its digital economy over the past decade. Government-led initiatives such as the “Digital Uzbekistan 2030” strategy and the establishment of IT parks in major cities have accelerated the expansion of technology enterprises across the country. In regional cities such as Urgench, the capital of the Khorezm region, IT companies and software development centers are increasingly active, yet systematic academic research on

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workforce dynamics in these emerging ecosystems remains very limited [State Program "Digital Uzbekistan– 2030", 2020; OECD, 2021].

Prior research conducted in developed IT economies consistently identifies salary competitiveness, career advancement opportunities, degree of professional autonomy, quality of managerial support, and adequacy of the working environment as the primary determinants of job satisfaction among IT workers [Deci & Ryan, 2000; Hackman & Oldham, 1976; Bakker & Demerouti, 2017; Carvalho et al., 2024; Kuutila et al., 2025]. However, the applicability of these findings to Uzbekistan's regional context — characterized by different economic conditions, cultural norms, organizational structures, and market maturity — has not been empirically tested.

This study addresses this gap by proposing a structured, replicable, and mathematically grounded methodological framework for measuring and modeling job satisfaction in IT organizations in Urgench. The framework integrates survey design, quantitative statistical analysis, and Structural Equation Modeling (SEM) into a unified research pipeline. By positioning job satisfaction as a system output within a Multi-Input Single-Output (MISO) socio-technical model, the study aligns organizational research with engineering-level analytical standards.

The primary objectives of this research are: (1) to identify and operationalize the key determinants of job satisfaction among IT professionals in Urgench; (2) to design and validate a psychometrically sound survey instrument; (3) to outline a rigorous analytical pipeline for testing hypothesized relationships; and (4) to provide a methodological model suitable for replication in comparable emerging IT ecosystems. The paper is structured as follows: Section 2 reviews relevant theoretical and empirical literature; Section 3 describes the research methodology and survey instrument; Section 4 details the planned data analysis strategy; Section 5 discusses expected findings and their implications; and Section 6 concludes with recommendations for future research.

LITERATURE REVIEW

Theoretical Foundations of Job Satisfaction

Job satisfaction has been studied extensively across multiple theoretical traditions. Herzberg's Two-Factor Theory (1959) distinguished between hygiene factors — such as salary, working conditions, and job security — that prevent dissatisfaction, and motivators — such as achievement, recognition, and growth opportunities — that generate genuine satisfaction. Although originally developed in manufacturing contexts, Herzberg's framework has been widely applied to IT environments, where motivators such as technical autonomy and professional development are particularly salient [Srivastava & Kanpur, 2014].

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Hackman and Oldham's (1976) Job Characteristics Model (JCM) proposed that skill variety, task identity, task significance, autonomy, and feedback are core job dimensions that influence experienced meaningfulness, responsibility, and knowledge of outcomes, ultimately determining satisfaction and performance. In software engineering environments, autonomy in selecting tools and frameworks and meaningful task assignment have been shown to be the strongest predictors of intrinsic motivation [Wang et al., 2024].

Deci and Ryan's (2000) Self-Determination Theory (SDT) further elaborates on intrinsic motivation by emphasizing the psychological needs for autonomy, competence, and relatedness. When IT professionals experience these needs as satisfied within their work environment, sustained engagement and high job satisfaction are the natural outcomes. Contemporary IT workforce research increasingly references SDT as a framework for understanding why non-financial factors often outweigh salary in predicting satisfaction levels [Colquitt et al., 2019].

The Job Demands–Resources (JD-R) model [Bakker & Demerouti, 2017] offers a complementary perspective by proposing that job resources — including supervisor support, growth opportunities, and organizational infrastructure — buffer against job demands and reduce burnout risk. This model has been empirically validated across IT sectors in Europe and Asia and provides a theoretically coherent basis for the present study's selection of independent variables [Rawashdeh, 2022; Kuutila et al., 2025].

Empirical Evidence from IT Workforce Studies

Carvalho et al. (2024) conducted a systematic review of job satisfaction research in software engineering contexts published between 2015 and 2023, identifying salary fairness, work–life balance, and opportunities for skill advancement as the three most frequently cited satisfaction determinants. The authors noted that studies from developing economies reported stronger sensitivity to salary and job security, while studies from mature IT markets placed higher emphasis on autonomy and intrinsic motivation.

Kuutila et al. (2025) examined emotional well-being and productivity among 312 software developers across five countries using experience sampling methodology. Their findings confirmed that daily fluctuations in perceived autonomy and leadership quality significantly predicted within-person variation in job satisfaction scores, with effect sizes comparable to salary satisfaction. Notably, career development access explained 18% of variance in long-term satisfaction ratings, making it the single strongest predictor in their structural model.

Nguyen et al. (2024) surveyed 280 IT professionals in Vietnam — a developing economy with structural similarities to Uzbekistan — and found that

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leadership support and organizational learning culture were the dominant predictors of retention intentions, mediated through job satisfaction. Their SEM model achieved fit indices of CFI = 0.94 and RMSEA = 0.06, confirming adequate structural validity.

Wang et al. (2024) analyzed a sample of 347 software engineers in China and reported that technical autonomy had the largest standardized path coefficient ($\beta = 0.41$, $p < 0.001$) on overall job satisfaction in their SEM model, followed by leadership support ($\beta = 0.29$) and career development ($\beta = 0.24$). Salary satisfaction, while significant ($\beta = 0.18$), ranked fourth in relative influence, suggesting that in rapidly developing IT markets, non-financial resources become increasingly important as base compensation improves.

Rawashdeh (2022) investigated the role of organizational environment and infrastructure quality on job satisfaction among IT workers in Jordan, finding that inadequate hardware resources, unreliable internet connectivity, and poor team communication tools significantly reduced satisfaction scores. This finding is particularly relevant for Urgench, where physical infrastructure limitations may compound psychological and organizational factors.

Within the Uzbek context, Tursunov (2022) and Yusupov & Mirzaev (2023) examined general workforce satisfaction in public sector organizations, but no published study has specifically targeted IT professionals in regional Uzbek cities. This gap motivates the present research and underscores its potential contribution to the regional academic and policy literature.

Conceptual Model and Hypotheses

Based on the theoretical frameworks and empirical evidence reviewed above, this study conceptualizes job satisfaction (JS) as the system output of five independently measured organizational inputs. The hypothesized relationships are formalized as follows:

H1: Salary satisfaction (SAL) has a significant positive effect on overall job satisfaction.

H2: Career development opportunities (CD) have a significant positive effect on overall job satisfaction.

H3: Job autonomy (JA) has a significant positive effect on overall job satisfaction.

H4: Leadership support (LS) has a significant positive effect on overall job satisfaction.

H5: Organizational environment (OE) has a significant positive effect on overall job satisfaction.

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These five hypotheses collectively constitute the structural model tested through SEM, operationalizing the general functional relationship:

$$JS = f(SAL, CD, JA, LS, OE)$$

RESEARCH METHODOLOGY

Research Design

This study adopts a cross-sectional quantitative survey design. The choice of a cross-sectional approach is grounded in its suitability for examining structural relationships among organizational variables at a single point in time, its cost-efficiency in data collection, and its compatibility with multivariate statistical methods including multiple regression and SEM [Creswell & Creswell, 2018; Hair et al., 2022]. Although longitudinal designs would allow examination of causal dynamics over time, cross-sectional SEM remains the dominant methodological paradigm in organizational job satisfaction research and is adequate for the present exploratory and confirmatory objectives.

Ethical principles governing the study include voluntary participation, fully informed consent prior to survey completion, complete anonymity of respondents, secure encrypted data storage, and the right to withdraw at any stage without consequence. Anonymity is particularly critical in organizational research to minimize social desirability bias, especially for items pertaining to salary perceptions and leadership evaluation [Podsakoff et al., 2003].

Population and Sampling Strategy

The target population consists of full-time IT professionals employed in software development companies, IT service firms, digital agencies, and technology departments of public institutions in Urgench, Uzbekistan. Based on available regional business registry data and IT park records, the estimated population size is approximately 400–600 active IT professionals in the Khorezm region.

A minimum sample size of 200 respondents is targeted, calculated using the rule-of-thumb of 10 observations per estimated model parameter [Hair et al., 2022]. The SEM model contains 5 latent variables measured by 3–4 indicators each (approximately 18–20 observed variables), yielding a minimum requirement of 180–200 participants. A target of 220–250 completed responses is sought to account for incomplete or invalid questionnaires.

Purposive sampling combined with snowball sampling will be employed. Initial contact will be established through IT park administration networks, LinkedIn professional groups, and direct outreach to registered IT companies in Urgench. Participation invitations will be distributed via secure online survey links. Inclusion criteria require respondents to be: (1) employed full-time in an IT-related

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role; (2) based in Urgench or the surrounding Khorezm region; and (3) having at least six months of experience in their current position.

Survey Instrument Design

The survey instrument is structured into three sections. Section A collects demographic and professional background information: age group, gender, highest educational qualification, current job title category (developer, analyst, project manager, system administrator, etc.), years of total IT experience, and monthly income bracket. These variables may function as control variables in extended regression models.

Section B measures the five independent latent constructs using validated multi-item scales adapted from established instruments in the organizational behavior literature [Spector, 1997; Hackman & Oldham, 1976; Bakker & Demerouti, 2017]. Each construct is measured by four Likert-scale items (1 = Strongly Disagree, 5 = Strongly Agree). Sample items are provided in Table 1 below.

Section C measures the endogenous construct — Overall Job Satisfaction — using four global satisfaction items adapted from the Minnesota Satisfaction Questionnaire (MSQ) short form [Weiss et al., 1967], including statements such as "I am satisfied with my current job overall" and "I would recommend my workplace to other IT professionals."

Table-1.

Sample Survey Items per Construct

Construct	Abbreviation	Sample Item	Scale
Salary Satisfaction	SAL	My compensation fairly reflects my technical expertise and workload.	1–5 Likert
Career Development	CD	My organization provides adequate training and professional growth opportunities.	1–5 Likert
Job Autonomy	JA	I can independently select the tools and methods I use to complete my tasks.	1–5 Likert

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Leadership Support	LS	My manager provides constructive feedback and supports my professional goals.	1–5 Likert
Organizational Environment	OE	The technical infrastructure and physical workspace adequately support my work.	1–5 Likert
Job Satisfaction	JS	Overall, I am satisfied with my current job in this organization.	1–5 Likert

Data Collection Procedure

Data will be collected via an anonymous online survey hosted on a secure platform (Google Forms or SurveyMonkey). Survey links will be distributed through three channels: (1) direct email invitation to IT company HR contacts and team leads; (2) posts in regional professional WhatsApp and Telegram groups; and (3) the IT Park Urgench official communication network. The survey will remain open for four weeks. Two reminder messages will be sent at day 10 and day 21 to improve response rates. A pilot test involving 20 IT professionals will be conducted before full-scale distribution to identify ambiguous items and refine the instrument.

PLANNED DATA ANALYSIS

Data Preprocessing

Prior to statistical analysis, the collected dataset will undergo a structured preprocessing pipeline. First, all questionnaire responses will be screened for completeness. Responses with more than 10% missing values will be excluded from analysis. For remaining missing values, multiple imputation using the Expectation-Maximization (EM) algorithm will be applied where appropriate.

Second, univariate outliers will be identified using standardized Z-scores. Observations with $Z > \pm 3.0$ on any measured variable will be flagged and examined contextually before a decision on exclusion is made:

$$Z = (X_i - \bar{X}) / SD$$

Third, normality of individual variables will be assessed through skewness and kurtosis statistics. Acceptable thresholds for parametric analysis are |Skewness| < 2.0 and |Kurtosis| < 7.0 [Hair et al., 2022]. Histograms and Q-Q plots will provide visual confirmation.

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Fourth, construct composite scores will be computed as the arithmetic mean of all valid items within each scale. Reliability of each composite will be assessed using Cronbach's alpha (α). The minimum acceptable threshold is $\alpha \geq 0.70$; $\alpha \geq 0.80$ is preferred:

$$\alpha = [k / (k - 1)] \times [1 - (\Sigma\sigma_i^2 / \sigma_T^2)]$$

Fifth, descriptive statistics (means and standard deviations) will be computed for all constructs to characterize the sample's perceptions across each organizational dimension.

Phase 1: Confirmatory Factor Analysis (CFA)

Before testing structural relationships, the measurement model will be evaluated through Confirmatory Factor Analysis (CFA) using maximum likelihood estimation in AMOS or R (lavaan package). CFA will verify that each observed indicator loads onto its intended latent factor and that the measurement model achieves adequate fit. The following validity criteria will be applied: standardized factor loadings $\lambda \geq 0.60$; Average Variance Extracted (AVE) ≥ 0.50 for convergent validity; Composite Reliability (CR) ≥ 0.70; and the square root of AVE exceeding inter-construct correlations for discriminant validity [Fornell & Larcker, 1981].

Model fit will be evaluated using the following global indices: $\chi^2/df < 3.0$; CFI ≥ 0.90; TLI ≥ 0.90; RMSEA ≤ 0.08; SRMR ≤ 0.08. If fit indices are inadequate, modification indices will guide respecification, provided changes are theoretically justified.

Phase 2: Correlation and Multiple Regression Analysis

Pearson bivariate correlation coefficients will be computed to examine preliminary associations between all predictor constructs and job satisfaction. This step identifies the direction and strength of relationships before controlling for inter-predictor overlap.

Multiple linear regression analysis will then be conducted with overall job satisfaction as the dependent variable and the five construct composites as independent predictors:

$$JS = \beta_0 + \beta_1(SAL) + \beta_2(CD) + \beta_3(JA) + \beta_4(LS) + \beta_5(OE) + \varepsilon$$

The model will be evaluated on the following criteria: coefficient of determination R^2 and adjusted R^2 indicating variance explained; F-statistic for overall model significance; standardized beta coefficients (β) for comparing relative predictor effect sizes; individual predictor p-values with Bonferroni correction applied for multiple testing; and Variance Inflation Factor (VIF < 5.0) to confirm absence of multicollinearity. Residual diagnostics will verify homoscedasticity and linearity assumptions.

Phase 3: Structural Equation Modeling (SEM)

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The full SEM will be estimated in a two-stage approach: the measurement model (CFA) is established first, followed by estimation of the structural model [Anderson & Gerbing, 1988]. The structural model specifies directional paths from the five exogenous latent constructs to the endogenous construct Job Satisfaction. In matrix notation:

$$X = \Lambda x\xi + \delta \quad \textit{(measurement model, exogenous)}$$
$$Y = \Lambda y\eta + \varepsilon \quad \textit{(measurement model, endogenous)}$$
$$\eta = B\eta + \Gamma\xi + \zeta \quad \textit{(structural model)}$$

For this study, since JS is the sole endogenous construct, the structural equation simplifies to:

$$JS = \gamma_1 SAL + \gamma_2 CD + \gamma_3 JA + \gamma_4 LS + \gamma_5 OE + \zeta$$

Maximum Likelihood Estimation (MLE) will minimize the discrepancy between the observed sample covariance matrix S and the model-implied covariance matrix $\Sigma(\theta)$:

$$F_ML = ln|\Sigma(\theta)| + trace(S\Sigma^{-1}(\theta)) - ln|S| - p$$

Standardized path coefficients γ_i will indicate both the magnitude and direction of influence of each predictor on job satisfaction, corrected for measurement error — a key advantage over simple regression. Hypotheses H1–H5 will be accepted if corresponding path coefficients are statistically significant ($p < 0.05$) with expected positive signs. Bootstrapping with 2,000 samples will be used to construct 95% bias-corrected confidence intervals for all path estimates.

SEM also enables decomposition of total effects into direct and indirect components, which is particularly valuable if, for example, leadership support influences career development, which in turn affects satisfaction — a mediated pathway undetectable in simple regression. The total effect is expressed as:

$$\textit{Total Effect} = \textit{Direct Effect} + \textit{Indirect Effect}$$

Table 2 summarizes the complete analytical pipeline and the software tools planned for each phase.

Table-2.

Planned Analytical Pipeline

Phase	Analysis Type	Purpose	Tool
0	Preprocessing & Reliability	Outlier detection, normality, Cronbach's α	SPSS / R
1	Confirmatory Factor Analysis	Validate measurement model, AVE, CR	AMOS / lavaan

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2	Correlation & Regression	Bivariate associations, OLS regression, VIF	SPSS / R
3	Structural Equation Modeling	Test H1–H5, path coefficients, model fit	AMOS / SmartPLS
4	Bootstrapping	Confidence intervals, indirect effects	R (boot package)

DISCUSSION AND EXPECTED FINDINGS

Although primary data collection is planned as the next empirical phase of this research, the theoretical framework and existing literature allow informed expectations regarding the likely findings. Based on comparable studies conducted in developing IT economies [Nguyen et al., 2024; Wang et al., 2024; Rawashdeh, 2022], career development and job autonomy are expected to emerge as the strongest predictors of overall job satisfaction among IT professionals in Urgench. This expectation reflects the profile of regional IT workers, many of whom are recent university graduates seeking professional advancement opportunities in a market where mentorship and structured career paths remain underdeveloped.

Salary satisfaction is expected to be a significant predictor, particularly given the economic context of Uzbekistan, where absolute compensation levels remain lower than in neighboring developed markets. However, consistent with SDT predictions [Deci & Ryan, 2000], salary may not be the dominant factor once autonomy and growth opportunities are controlled for. This pattern would align with Wang et al.'s (2024) Chinese IT sample, where salary ranked fourth in relative importance among the five predictors.

Leadership support is expected to show a significant positive effect, particularly because regional IT organizations often have flat management structures where direct supervisor behaviour has a disproportionate influence on team-level satisfaction. Poor managerial practices — including micromanagement, unclear performance feedback, and limited recognition — are frequently cited complaints in informal IT professional communities in Uzbekistan.

Organizational environment, encompassing hardware quality, internet reliability, and workspace adequacy, may exhibit stronger effects in Urgench than reported in studies from more developed markets. Infrastructure limitations specific to the Khorezm region — including intermittent power supply and limited access to high-speed internet — represent real operational constraints that may

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substantially reduce daily productivity and therefore job satisfaction [Rawashdeh, 2022].

From a systems engineering perspective, the SEM model is expected to achieve an R^2 value of approximately 0.55–0.65 for job satisfaction, indicating that the five organizational inputs collectively explain the majority of measurable variance in the system output. This would confirm the adequacy of the MISO conceptualization and support the framework's application in organizational performance optimization.

The findings are also expected to carry direct practical implications. If career development emerges as the dominant predictor, regional IT managers and HR practitioners should prioritize structured mentorship programs, access to international online certification platforms (such as Coursera or Udemy), and transparent internal promotion pathways. If leadership support proves critical, targeted management training programmes become the priority intervention. Such evidence-based recommendations represent a transition from anecdotal management practice toward data-driven organizational governance — a shift particularly needed in emerging IT ecosystems.

CONCLUSION AND RECOMMENDATIONS

This study has presented a rigorous, reproducible, and theoretically grounded methodological framework for investigating job satisfaction among IT professionals in Urgench, Uzbekistan. By integrating validated survey design, multi-phase quantitative analysis, and Structural Equation Modeling within a socio-technical systems perspective, the framework operationalizes job satisfaction as a measurable organizational performance indicator rather than a purely subjective psychological state.

The five-construct model — encompassing salary satisfaction, career development, job autonomy, leadership support, and organizational environment — is grounded in established theories including Herzberg's Two-Factor Theory, the Job Characteristics Model, Self-Determination Theory, and the Job Demands–Resources framework. The planned analytical pipeline ensures that each hypothesis will be evaluated with appropriate statistical rigor, including measurement validation through CFA, regression-based effect size estimation, and full SEM path analysis with bootstrapped confidence intervals.

The primary contribution of this research is methodological: it provides an explicit, step-by-step analytical framework that can be directly replicated by researchers studying IT workforce dynamics in other regional cities of Uzbekistan or in comparable emerging digital economies across Central Asia. A secondary contribution lies in generating the first systematic quantitative evidence base on IT

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job satisfaction in the Khorezm region, which can inform human resource policies, organizational development strategies, and academic curricula at Urgench State University.

Future research directions include: (1) conducting the planned empirical data collection and testing the proposed model; (2) extending the framework with mediation and moderation analyses (e.g., examining whether gender or experience level moderates the effect of autonomy on satisfaction); (3) comparing results across multiple Uzbek cities to identify regional variation; and (4) integrating machine learning approaches such as Random Forest feature importance analysis to complement SEM findings and identify non-linear relationships among predictors.

In conclusion, this study establishes a robust methodological foundation for evidence-based IT workforce management in Urgench and contributes to the broader scholarly conversation on job satisfaction in emerging technology economies.

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