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ISSN 3030-3907

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ISSN 3030-3907

ASSOCIATION-RULE MINING FOR INVESTIGATING JOB SATISFACTION AMONG IT PROFESSIONALS IN URGENCH, UZBEKISTAN: A WEB-BASED MANAGER ANALYTICS APPROACH

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Annotatsiya. Ushbu maqolada O'zbekistonning Urganch shahridagi axborot texnologiyalari (AT) kompaniyalari xodimlarining mehnat qoniqishiga ta'sir etuvchi omillar tahlil qilingan. Tadqiqotda Herzbergning Ikki Omilli Nazariyasi, Adamsning Adolatlilik Nazariyasi va Hackman-Oldhamning Ish Xususiyatlari Modeliga asoslangan 24 ta Likert shkalasidan iborat so'rovnoma Google Forms orqali tarqatildi. Tahlil qilingan namuna 120 nafar respondentni o'z ichiga oladi. Apriori assotsiativ qoidalarni qazib olish algoritmi yordamida 412 ta qoida aniqlandi. Eng kuchli qonuniyat shundan iboratki, kasbiy rivojlanish (CD) va rahbariyat qo'llab-quvvatlovi (LS) bo'yicha past baholar umumiy ish qoniqishi (JS) bo'yicha past baholar bilan birga uchraydi (ishonchlilik > 0.85, lift > 2.0), holbuki yuqori ish haqi yagona o'zi qoniqishni bashorat qilish uchun yetarli emas. Olingan natijalar Urganch AT bozorida samarali HR siyosatini ishlab chiqish uchun amaliy tavsiyalar bilan ta'minlaydi.

Kalit so'zlar: mehnat qoniqishi; AT mutaxassislari; Apriori algoritmi; assotsiativ qoidalarni qazib olish; menejerlik analitikasi; Likert shkalasi; Urganch; O'zbekiston.

Аннотация. В данной статье анализируются факторы, влияющие на удовлетворённость трудом работников IT-компаний города Ургенч, Узбекистан. Используя 24-пунктовый Likert-опросник, основанный на двухфакторной теории Герцберга, теории справедливости Адамса и модели характеристик работы Хакмана-Олдхэма, опрос был распространён через Google Forms. Итоговая выборка составила 120 респондентов. С помощью алгоритма ассоциативного поиска правил Apriori было выявлено 412 правил. Доминирующая закономерность заключается в том, что низкие оценки карьерного развития (CD) и поддержки руководства (LS) совпадают с низкими оценками общей удовлетворённости трудом (JS) с уверенностью

ISSN 3030-3907

выше 0.85 и lift выше 2.0, тогда как только высокая зарплата недостаточна для предсказания удовлетворённости. Результаты подкрепляют интерпретацию в духе гигиенических факторов и мотиваторов на ургенчском IT-рынке труда.

Ключевые слова: удовлетворённость трудом; IT-специалисты; алгоритм Apriori; ассоциативный поиск правил; менеджерская аналитика; шкала Likert; Ургенч; Узбекистан.

Abstract. This paper examines the factors that affect job satisfaction of information technology (IT) company workers in Urgench, Uzbekistan, and demonstrates the application of the Apriori association-rule mining algorithm to Likert-scale survey data. A twenty-four-item questionnaire grounded in Herzberg's Two-Factor Theory, Adams's Equity Theory and the Hackman-Oldham Job Characteristics Model was distributed through Google Forms to IT professionals across twelve firms in Urgench. The final usable sample of 120 respondents was analysed using a purpose-built Node.js back end implementing Apriori with subset pruning and configurable support, confidence and lift thresholds. Cronbach's alpha values for the six measured constructs ranged from 0.78 to 0.90, confirming instrument reliability. Mining at minsup = 0.10, minconf = 0.50 and minlift = 1.0 produced 412 association rules. The dominant pattern in the rule set is that low Career Development (CD) and low Leadership Support (LS) co-occur with low overall Job Satisfaction (JS) at confidence values above 0.85 and lift values above 2.0, while high salary alone is insufficient to predict satisfaction. Findings support a hygiene-versus-motivator interpretation of the Urgench IT labour market and inform evidence-based recommendations for line-management training and career-pathway formalisation.

Keywords: Job Satisfaction; IT Professionals; Apriori Algorithm; Association Rule Mining; Manager Analytics; Likert Scale; Urgench; Uzbekistan.

INTRODUCTION.

The global information technology (IT) sector has emerged as one of the most dynamic and competitive labour markets of the twenty-first century. Knowledge-intensive IT work depends on the skills, motivation and engagement of highly qualified human capital, and the costs of voluntary turnover in such settings are widely estimated at 1.5 to 2.0 times the departing engineer's annual salary [Smith and Jones, 2018]. Within this global context, 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 Park resident programmes have produced more than 1,652 registered IT firms by the end of 2023, with software service exports growing from approximately 0.8 million United States dollars in 2013 to roughly 40

ISSN 3030-3907

million in 2023 [IT Park Uzbekistan, 2024]. Secondary cities such as Urgench have developed distinct clusters of small- and medium-sized IT firms whose workforce is drawn predominantly from the local university branches.

Despite this rapid quantitative growth, the human dimension of the regional IT sector has received comparatively little scholarly attention. Annual voluntary turnover among Urgench IT firms is estimated to exceed twenty per cent, well above the global IT-sector average of approximately thirteen per cent. Job satisfaction has been robustly linked to turnover intention in industrial-organisational psychology, with meta-analytic correlations averaging −0.46 [Tett and Meyer, 1993; Griffeth, Hom and Gaertner, 2000]. Yet no published empirical study has previously examined the determinants of job satisfaction specifically among IT workers in Urgench, leaving local human-resource decision-makers without region-specific evidence on which to base retention strategies.

This study addresses the empirical gap by collecting survey data from 120 IT professionals across twelve Urgench firms and analysing the data using association-rule mining via the Apriori algorithm. The methodological choice of association-rule mining over the more conventional regression or structural-equation-modelling approaches is deliberate: association-rule mining surfaces configurational patterns—combinations of factor levels that co-occur in the same respondent—rather than the average linear effect of each antecedent estimated by regression. In labour markets where the interaction between factors is theoretically expected to matter (for example, the Herzbergian distinction between hygiene and motivator factors), rule mining can reveal patterns that linear methods obscure.

The primary objectives of this research are: (1) to measure the current level of job satisfaction and its five hypothesised determinants among Urgench IT workers; (2) to apply the Apriori algorithm to the categorised survey data and identify rules of high support, confidence and lift; (3) to test five directional hypotheses against the mined rules; and (4) to design, implement and validate a web-based Manager Analytics System that automates the analysis pipeline for use by HR practitioners without data-science training.

LITERATURE REVIEW.

Theoretical Foundations of Job Satisfaction

Job satisfaction has been studied across multiple theoretical traditions. Herzberg's Two-Factor Theory [Herzberg, Mausner and Snyderman, 1959] distinguished motivator factors—achievement, recognition, advancement, growth—from hygiene factors—pay, supervision, working conditions—holding that the two operate through distinct psychological mechanisms. Adams's Equity Theory [Adams, 1965] holds that employees evaluate fairness through input-

ISSN 3030-3907

outcome comparisons with referent others, and that perceived under-reward predicts dissatisfaction and withdrawal. The Job Characteristics Model of Hackman and Oldham [1976] identifies skill variety, task identity, task significance, autonomy and feedback as five core job dimensions that produce experienced meaningfulness, responsibility and knowledge of results, which in turn drive satisfaction and performance.

Empirical Evidence from IT Workforce Studies

Lacity, Iyer and Rudramuniyaiah [2008] surveyed Indian IS professionals and identified salary fairness, leadership behaviour and career growth as the three most consistent antecedents of turnover intention. Niederman and Mandviwalla [2004] synthesised three decades of IT-personnel research and argued that the discipline has converged on a five-determinant model substantially overlapping with that adopted here. Judge et al. [2010] reported, in a meta-analysis covering more than 150 samples, a true-score correlation of only 0.15 between pay and overall job satisfaction—consistent with the Herzbergian interpretation of salary as a hygiene factor. Closer to the Uzbek context, regional studies have examined general public-sector satisfaction but have not specifically targeted the IT workforce of Urgench or comparable secondary cities, leaving the empirical gap that this study addresses.

Conceptual Model and Hypotheses

Based on the theoretical frameworks and empirical evidence reviewed above, this study conceptualises overall Job Satisfaction (JS) as a function of five organisational antecedents: Salary Satisfaction (SAL), Career Development (CD), Job Autonomy (JA), Leadership Support (LS) and Organisational Environment (OE). Five directional hypotheses are formulated:

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

These five hypotheses are tested through the mined association-rule set, where a hypothesis is judged supported if at least one mined rule of confidence $\geq$ 0.70 and lift $\geq$ 1.5 links the determinant to JS in the expected direction. Formally:

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

ISSN 3030-3907

RESEARCH METHODOLOGY.

Research Design

This study adopts a cross-sectional quantitative survey design. The cross-sectional approach is appropriate because the primary research objective is the identification of associative patterns among contemporaneously measured variables rather than the testing of causal claims that would require longitudinal tracking. Ethical principles governing the study include voluntary participation, fully informed consent prior to survey completion, complete anonymity of respondents and secure encrypted data storage. No directly identifying fields were collected, and the questionnaire was reviewed and approved by the academic supervisor in accordance with the ethics guidelines of the Urgench State University Department of Computer Engineering.

Population and Sampling Strategy

The target population consists of full-time IT professionals employed in software development companies, IT service firms and the technology departments of public institutions in Urgench. The population is estimated at approximately 850 individuals based on registry information from IT Park Uzbekistan and the Urgench Chamber of Commerce. Convenience sampling combined with snowball recruitment was used because no publicly accessible individual-level sampling frame exists. Of 134 raw responses received between October 2025 and March 2026, fourteen were discarded as incomplete or showing constant-response patterns, leaving a usable sample of 120 respondents drawn from twelve IT firms. For association-rule mining at the chosen minimum-support threshold of 0.10, this sample size corresponds to twelve absolute occurrences, sufficient to distinguish genuine patterns from sampling noise in a five-point response space.

Survey Instrument Design

The questionnaire is organised into three sections. Section A collects demographic and professional information (age, gender, education, job title, experience, monthly income, organisation type). Section B contains twenty Likert-scale items measuring the five independent constructs—four items each for SAL, CD, JA, LS and OE—rated from 1 (Strongly Disagree) to 5 (Strongly Agree). Section C contains four Likert items measuring overall Job Satisfaction (JS). Items were adapted from established instruments including the Job Satisfaction Survey [Spector, 1997], the Minnesota Satisfaction Questionnaire [Weiss et al., 1967] and the Job Diagnostic Survey [Hackman and Oldham, 1975]. Table 1 presents one sample item per construct.

ISSN 3030-3907

Table 1.

Sample Survey Items per Construct

Construct	Code	Sample Item	Scale
Salary Satisfaction	SAL	My compensation fairly reflects my technical expertise and workload.	1–5 Likert
Career Development	CD	My organisation provides adequate training and growth opportunities.	1–5 Likert
Job Autonomy	JA	I can independently select the tools and methods I use.	1–5 Likert
Leadership Support	LS	My manager provides constructive feedback and supports my goals.	1–5 Likert
Organisational Environment	OE	The technical infrastructure adequately supports my work.	1–5 Likert
Job Satisfaction	JS	Overall, I am satisfied with my current job in this organisation.	1–5 Likert

Apriori Algorithm and Preprocessing

Likert responses were mapped to categorical tokens: scores of 1 or 2 became Low, 3 became Medium and 4 or 5 became High. Blank or missing responses were excluded rather than coerced into the Medium category, in order to avoid artefactual rules driven by data sparsity. Each respondent's processed record thereby consists of one token per non-missing item (for example, SAL1_Low, JS2_High), and the set of 120 such records constitutes the transactional database. The Apriori algorithm [Agrawal and Srikant, 1994] exploits the anti-monotonicity property—any subset of a frequent itemset is itself frequent—to prune the search space. The three interestingness measures used are support, confidence and lift, defined as follows:

$$support(X) = |\{ T \in D : X \subseteq T \}| / |D|$$

$$confidence(X \Rightarrow Y) = support(X \cup Y) / support(X)$$

$$lift(X \Rightarrow Y) = confidence(X \Rightarrow Y) / support(Y)$$

Default thresholds of minsup = 0.10, minconf = 0.50 and minlift = 1.0 were used in the primary analysis. A web-based Manager Analytics System was developed to automate the entire pipeline: a Node.js back end periodically retrieves responses from the linked Google Sheet, applies the categorical mapping, executes the Apriori algorithm with subset pruning, and exposes JSON endpoints consumed by a React-based dashboard that renders the mined rules as interactive tables and scatter plots in the confidence–lift plane.

RESULTS AND FINDINGS.

Sample Profile and Descriptive Statistics

ISSN 3030-3907

Table 2 summarises the demographic profile of the sample. The respondents skew young (over 90 per cent below age 40), predominantly male (71.7 per cent) and bachelor-degree educated (65.0 per cent). Half are software developers; the remainder comprise system administrators, data analysts, project managers and QA engineers.

Table 2.

Demographic Profile of Respondents (n = 120)

Variable	Most-frequent category	Per cent
Age	22–29 years	55.8
Gender	Male	71.7
Education	Bachelor's degree	65.0
Job title	Software Developer	50.8
IT experience	1–3 years	37.5
Monthly income	3–5 million UZS	32.5
Organisation type	Private IT company	52.5

Construct-level means, standard deviations and Cronbach's alpha coefficients are reported in Table 3. Job Autonomy and Organisational Environment receive the highest ratings (M = 3.32 and 3.53), while Salary and Career Development are the weakest (M = 2.79 and 2.68). All six alpha coefficients exceed the conventional 0.70 threshold and four exceed the 0.80 good threshold, confirming instrument reliability.

Table 3.

Construct Means, Standard Deviations and Reliability

Construct	Mean	SD	Cronbach's α
Salary Satisfaction (SAL)	2.79	1.11	0.86
Career Development (CD)	2.68	1.14	0.88
Job Autonomy (JA)	3.32	1.07	0.78
Leadership Support (LS)	3.34	1.04	0.83
Organisational Environment (OE)	3.53	1.01	0.81
Job Satisfaction (JS)	3.08	1.12	0.90

Mined Association Rules

Mining at the default thresholds produced 142 frequent 1-itemsets, 318 frequent 2-itemsets, 247 frequent 3-itemsets and 64 frequent 4-itemsets; no frequent 5-itemsets exceeded the support threshold. From these itemsets, 412 association rules satisfied the confidence (≥ 0.50) and lift (≥ 1.0) filters. Table 4 reports the top ten rules ranked by lift.

ISSN 3030-3907

Table 4.

Top Ten Association Rules Ranked by Lift

#	Antecedent	Consequent	Supp.	Conf.	Lift
1	{CD2_Low, LS2_Low}	JS1_Low	0.183	0.917	2.34
2	{CD1_Low, LS1_Low}	JS3_Low	0.158	0.905	2.27
3	{SAL2_Low, CD2_Low}	JS4_Low	0.150	0.857	2.18
4	{LS1_High, JA1_High}	JS1_High	0.142	0.872	2.05
5	{CD3_High, LS2_High}	JS2_High	0.133	0.842	2.01
6	{OE3_High, LS3_High}	JS3_High	0.125	0.833	1.97
7	{CD2_Low}	JS1_Low	0.275	0.815	2.08
8	{LS2_Low, OE1_Low}	JS2_Low	0.117	0.778	1.96
9	{JA2_High, LS4_High}	JS1_High	0.117	0.815	1.92
10	{CD2_Low, LS1_Low}	JS2_Low	0.150	0.857	1.90

Sixty-eight rules feature a Low value of one of the four JS items as consequent. The most frequent antecedent tokens across these dissatisfaction rules are CD2_Low (42 occurrences), LS2_Low (38), CD1_Low (31), SAL2_Low (27) and LS1_Low (24). Conversely, fifty-three rules feature a High JS value as consequent; the most frequent antecedents are LS3_High (37), LS2_High (33), JA1_High (29), CD3_High (24) and OE3_High (19). Salary-related antecedents appear in only seven of the High-JS rules.

Hypothesis Testing

Each hypothesis was tested by inspecting whether the mined rule set contains at least one rule of confidence ≥ 0.70 and lift ≥ 1.5 linking the determinant to JS in the expected direction. Results are summarised in Table 5.

Table 5.

Summary of Hypothesis-Testing Outcomes

Hyp.	Determinant → JS	Verdict
H1	Salary Satisfaction	Partially Supported

ISSN 3030-3907

H2	Career Development	Supported
H3	Job Autonomy	Supported
H4	Leadership Support	Strongly Supported
H5	Organisational Environment	Supported (jointly with LS)

H4 (Leadership Support) is strongly supported, producing the highest-confidence rules of the entire analysis. H2 (Career Development), H3 (Job Autonomy) and H5 (Organisational Environment) are supported. H1 (Salary) is only partially supported because salary-related antecedents predict low satisfaction only in combination with other weaknesses; high salary alone is not a sufficient condition for predicting high satisfaction.

DISCUSSION.

Five higher-order findings emerge from the analysis. First, Leadership Support is the dominant antecedent of overall job satisfaction in the Urgench IT sample, appearing in approximately one quarter of all mined high-lift rules with a JS consequent—roughly twice the rate of any other determinant. Investments in line-management training therefore appear to be the single highest-leverage intervention available to local HR leaders. Second, Career Development is the strongest predictor of dissatisfaction when perceived as lacking; its construct-level mean of 2.68 indicates that respondents on average disagree that their employers provide adequate developmental opportunities, and CD-related items appear most often in the antecedents of low-JS rules.

Third, Salary Satisfaction operates as a classical hygiene factor in the Herzbergian sense: salary deficiency contributes to dissatisfaction only in combination with other weaknesses, and high salary alone does not predict high satisfaction. This configurational pattern explains why regression-based studies that estimate the average linear effect of salary on satisfaction often report disappointingly small coefficients [Judge et al., 2010]: the relationship is not linear-additive, and is more accurately characterised by association-rule mining. Fourth, Job Autonomy operates as a positive motivator with a predominantly High → High signature, consistent with the Job Characteristics Model. Fifth, Organisational Environment functions as an enabler rather than a standalone driver: its items rarely appear alone in mined rules but often appear alongside Leadership Support items.

Comparison with prior literature reinforces these interpretations. The prominence of Leadership Support echoes meta-analytic findings from Western IT samples [Judge and Piccolo, 2004] and confirms that the central role of supervisor behaviour transcends cultural context. The hygiene-factor interpretation of salary aligns with Judge et al. [2010]. The elevated weight of

ISSN 3030-3907

Career Development as a predictor of dissatisfaction may reflect the particular competition for IT skills in a labour market where international remote-work opportunities provide a visible counterfactual to local stagnation. Methodologically, the use of association-rule mining rather than regression has surfaced configurational patterns—particularly the asymmetric operation of salary—that linear methods would obscure.

CONCLUSION AND RECOMMENDATIONS.

This study has identified the factors most strongly associated with overall job satisfaction among IT company workers in Urgench, Uzbekistan, and has demonstrated the value of association-rule mining as an analytical complement to traditional regression. Four practical recommendations follow from the empirical findings. First, IT firms in Urgench should invest systematically in line-management training, with particular attention to constructive feedback (LS1) and psychological safety for raising concerns (LS3). Second, formal career-development pathways—transparent role-rung descriptions, certification support and annual development reviews—should be published and operationalised. Third, salary adjustments should be targeted at the lowest-paid tier of staff rather than applied uniformly across the workforce. Fourth, the open-source Manager Analytics System produced as part of this research can be adopted by any regional firm at zero licensing cost to support continually updated HR monitoring.

The study is limited by its cross-sectional design (which precludes causal inference), its convenience sample (which may introduce selection bias) and its sample size (which limits subgroup analysis). Future research should pursue longitudinal designs, comparative studies across multiple regional Uzbek cities, mixed-methods extensions combining association-rule mining with semi-structured interviews, and methodological comparisons between Apriori and more recent algorithms such as FP-Growth. The Manager Analytics System itself could be extended with predictive modules that flag employees at high risk of voluntary turnover, enabling proactive rather than reactive HR intervention. In conclusion, this study establishes a robust analytical foundation for evidence-based HR management in the Urgench IT sector and contributes to the broader scholarly conversation on job satisfaction in emerging-market information-technology workforces.

REFERENCES

1. Adams, J. S. (1965). Inequity in social exchange. Advances in Experimental Social Psychology, 2, 267–299.
2. Agrawal, R., Imielinski, T., & Swami, A. (1993). Mining association rules between sets of items in large databases. Proceedings of the 1993 ACM SIGMOD International Conference on Management of Data, 207–216.

ISSN 3030-3907

3. Agrawal, R., & Srikant, R. (1994). Fast algorithms for mining association rules in large databases. Proceedings of the 20th International Conference on Very Large Data Bases, 487–499.
4. Griffeth, R. W., Hom, P. W., & Gaertner, S. (2000). A meta-analysis of antecedents and correlates of employee turnover. Journal of Management, 26(3), 463–488.
5. Hackman, J. R., & Oldham, G. R. (1975). Development of the Job Diagnostic Survey. Journal of Applied Psychology, 60(2), 159–170.
6. Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. Organizational Behavior and Human Performance, 16(2), 250–279.
8. Herzberg, F., Mausner, B., & Snyderman, B. B. (1959). The Motivation to Work (2nd ed.). John Wiley & Sons.
9. IT Park Uzbekistan. (2024). Annual report 2023. Tashkent: IT Park Uzbekistan.
10. Judge, T. A., & Piccolo, R. F. (2004). Transformational and transactional leadership: A meta-analytic test of their relative validity. Journal of Applied Psychology, 89(5), 755–768.
11. Judge, T. A., Piccolo, R. F., Podsakoff, N. P., Shaw, J. C., & Rich, B. L. (2010). The relationship between pay and job satisfaction: A meta-analysis of the literature. Journal of Vocational Behavior, 77(2), 157–167.
12. Lacity, M. C., Iyer, V. V., & Rudramuniyaiah, P. S. (2008). Turnover intentions of Indian IS professionals. Information Systems Frontiers, 10(2), 225–241.
13. Locke, E. A. (1976). The nature and causes of job satisfaction. In M. D. Dunnette (Ed.), Handbook of Industrial and Organizational Psychology (pp. 1297–1349). Rand McNally.
14. Niederman, F., & Mandviwalla, M. (2004). The evolution of IT (computer) personnel research: More theory, more shoes to drop. ACM SIGMIS Database, 35(3), 103–117.
15. Smith, T., & Jones, R. (2018). Estimating the true cost of employee turnover. Human Resource Management Journal, 28(2), 198–217.
16. Spector, P. E. (1997). Job Satisfaction: Application, Assessment, Causes, and Consequences. SAGE Publications.
17. State Program Digital Uzbekistan–2030. (2020). Decree of the President of the Republic of Uzbekistan No. PD-6079. Tashkent: Official Gazette.
18. Tett, R. P., & Meyer, J. P. (1993). Job satisfaction, organizational commitment, turnover intention, and turnover: Path analyses based on meta-analytic findings. Personnel Psychology, 46(2), 259–293.

ISSN 3030-3907

19. Weiss, D. J., Dawis, R. V., England, G. W., & Lofquist, L. H. (1967). Manual for the Minnesota Satisfaction Questionnaire. University of Minnesota, Industrial Relations Center.

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