A Data-Driven Decision-Support Model for Evaluating Managerial Performance in Local Government

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Abstract: In the context of today's rapidly developing environment, improving management effectiveness is one of the key tasks not only for public institutions but also for all types of organizations. The need for scientific research in this field has been steadily increasing in order to ensure continuous improvement of management systems. This study proposes a data-driven decision-support model for evaluating managerial performance in local government based on KPI systems and statistical analysis. This article empirically analyzes the factors affecting the effectiveness of managerial staff performance in local government. The study was conducted using the case of the Karshi district administration, and data were collected through a social survey method. The obtained data were processed using the SPSS statistical software through descriptive statistics, factor analysis, and Pearson correlation analysis. The results of the study identified the main factors that negatively affect management effectiveness. During the research process, the central importance of certain KPI indicators was statistically confirmed. Based on the findings, practical recommendations were developed to improve the system for evaluating the performance of managerial staff in local government. The research results indicate that the tasks related to evaluating management effectiveness can be addressed through the implementation of modern and scientifically grounded methods. The combined application of strategic evaluation models such as the Balanced Scorecard and specific measurement tools such as KPI indicators enables an objective assessment of managerial performance. The proposed approach contributes to applied IT by formalizing KPI evaluation into a computational model and enabling its implementation as a digital decision-support system for public administration. This article is based on the author's dissertation entitled "Improving the Evaluation of the Effectiveness of Management Activities of Managerial Staff in Local Government (Case of Karshi District Administration)" (2025, No. 312, Tashkent State Transport University).

1 INTRODUCTION

Improving and objectively assessing the effectiveness of managerial staff is one of the key tasks of public administration. In modern management conditions, evaluation systems based solely on traditional reports and statistical indicators cannot fully reflect the real results and social impact of organizational activities. Therefore, there is a growing need to assess managerial performance using result-oriented, clear, and measurable criteria.

Although a regulatory framework aimed at improving management effectiveness has been formed in local government, several problems remain in practice. In particular, insufficient linkage between KPIs and strategic goals, failure to consider regional characteristics, and weak monitoring mechanisms reduce overall effectiveness [1]. While foreign studies widely address these issues, empirical analysis under local conditions remains limited [2] - [4].

The scientific novelty of this research lies in the empirical identification of factors influencing managerial performance in the Karshi district administration through social surveys and statistical analysis. The relationships among KPIs were also

empirically assessed, allowing the development of practical recommendations to enhance management effectiveness. Furthermore, the integration of data-driven workflows aligns with broader contemporary shifts toward secure IoT networks and digitized organizational risk workflows in state infrastructure systems [5], [6].

In addition, the study positions KPI-based evaluation within the context of digital governance by proposing its transformation into a data-driven and computational decision-support system.

This study makes the following contributions:

1) It provides an empirical dataset based on a social survey conducted among local government officials for evaluating KPI systems.
2) It proposes a structured approach for reducing performance indicators from 184 to 76 using expert evaluation and statistical validation.
3) It identifies the factor structure of KPI systems using factor analysis techniques.
4) It reveals significant relationships among KPIs through correlation analysis, highlighting central indicators such as KPI_12.
5) It develops a data-driven decision-support framework for improving KPI-based performance evaluation in local government.

2 LITERATURE REVIEW

Various approaches to performance evaluation in public administration have been discussed in international and local studies. The Balanced Scorecard (BSC) developed by Kaplan and Norton provides a comprehensive framework that integrates financial and non-financial indicators, including internal processes and organizational development [7].

Hatry emphasizes the importance of strategic alignment, efficient resource utilization, and continuous monitoring in improving performance in the public sector [8]. OECD studies highlight that regional characteristics, socio-economic conditions, and institutional capacity should be considered when designing KPI systems, as standardized indicators may not be effective across different regions [9], [10].

Previous studies have examined the theoretical and practical aspects of KPI systems and their application in management [11] - [14]. However, despite extensive research, there remains a lack of empirical and data-driven studies that systematically analyze the factors influencing managerial performance at the local level.

This study addresses this gap by applying statistical methods and proposing a data-driven decision-support approach.

3 METHODS

The study employed system analysis, comparison, generalization, and sociological research methods. The theoretical framework was based on international and national literature, regulatory documents, and conceptual approaches in public administration and management.

The empirical study was conducted based on a structured survey involving 153 respondents from local government, including deputy regional governors, department heads, and specialists. The quantitative approach and data-driven methodologies utilized in this framework build upon mathematical and structural evaluation models previously validated in infrastructure and communication systems [15] - [17].

The survey consisted of multiple sections, including:

1) general assessment of the current performance evaluation system;
2) evaluation of KPI indicators;
3) expert-based selection of relevant indicators.

A subgroup of respondents, including 10 specialists and experts, participated in a detailed evaluation of KPI indicators using a three-point scale (1-should be included, 2-not important, 3-not applicable).

Initially, 184 KPI indicators were identified based on regulatory documents and literature review. These indicators were then filtered using expert evaluation. Indicators that received the majority of “should be included” responses and met consistency criteria were selected, resulting in a final set of 76 indicators.

To ensure the reliability and validity of the selected indicators, statistical analysis was conducted using SPSS software. Factor analysis was applied to identify the underlying structure of the KPI system. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett’s test of sphericity were used to assess data suitability for factor analysis. Principal Component Analysis (PCA) with Varimax rotation was applied, and factors with eigenvalues greater than 1 were retained.

To further validate the selected indicators, Pearson correlation analysis was conducted to examine relationships among KPIs. Statistical significance was determined at the $p < 0.05$ level.

Algorithm for KPI Evaluation:

Step 1: Collect survey and administrative data

Step 2: Preprocess and clean data

Step 3: Apply factor analysis to reduce indicators

Step 4: Conduct correlation analysis to identify relationships

Step 5: Select central KPIs based on statistical significance

Step 6: Generate performance scores

Step 7: Provide decision-support outputs

Mathematical Representation of the Model:

The decision-support process is formalized as:

$$P = \sum (w_i \times KPI_i), \quad i = 1 \ldots n, \qquad (1)$$

where P is the overall performance score, KPI_i are the selected performance indicators, and w_i are the weights derived from factor loadings and correlation coefficients.

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Input: KPI values (KPI₁, KPI₂, … KPIₙ)
Output: Performance score P.
For each KPI:
Multiply KPI value by its weight (wᵢ).
Sum all weighted values.
Return total score P.
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Algorithm 1: The model can be implemented programmatically as follows.

The weights are dynamically adjusted based on statistical significance, ensuring adaptive evaluation of managerial performance. Such implementations follow rigorous precedents in computational modeling, metrological calibration, and digital monitoring workflows across diverse operational management platforms [18] - [21].

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.78, indicating acceptable suitability for factor analysis. Bartlett's Test of Sphericity was statistically significant ($\chi^2 = 412.56$, $df = 120$, $p < 0.001$), confirming that the correlation matrix was appropriate for factor analysis. The extracted factors explained 68.4% of the total variance. Cronbach's alpha values for the identified factors ranged from 0.71 to 0.83, indicating acceptable internal consistency. Factor loadings for key indicators exceeded 0.60, confirming strong relationships between variables and their respective components.

4 RESEARCH RESULTS

The evaluation system in public administration plays an important role in identifying problem areas, improving resource allocation, and increasing accountability. The case of the Karshi district administration demonstrates the growing importance of data-driven approaches in performance evaluation.

To identify the factors influencing managerial performance in local government, a social survey was conducted among regional and district-level employees. Their perceptions of the existing evaluation system were analyzed.

A total of 153 respondents participated in the survey. Based on their responses, 76 out of 184 KPIs were selected through expert evaluation. Factor analysis confirmed the structural validity of the selected indicators.

The analysis identified several key factors explaining a significant proportion of the total variance. The rotated component matrix showed strong loadings of specific KPIs within each factor group, confirming internal consistency. Reliability analysis using Cronbach's alpha indicated acceptable levels of internal consistency for the extracted factors.

A subgroup of 10 experts evaluated each KPI indicator using a three-point scale: 1 (should be included), 2 (not important), and 3 (not applicable).

Descriptive analysis revealed variability in respondents' perceptions across KPIs.

Correlation analysis was conducted using the Pearson coefficient, and statistically significant relationships among the KPIs were identified. For instance, the correlation between KPI_3 and KPI_5 was negative ($r = -0.677$, $p = 0.011$), indicating an inverse relationship. KPI_4 showed positive correlations with KPI_5 and KPI_7 ($r \approx 0.594$), suggesting that changes in one organizational process affect others. A very strong negative correlation was found between KPI_6 and KPI_9 ($r = -0.887$), indicating opposite trends.

KPI_8 was positively correlated with KPI_2 and KPI_7, and negatively correlated with KPI_9, demonstrating its influence across multiple areas. KPI_12 was identified as a central indicator due to its strong correlations with multiple KPIs. Table 1 presents the relationships between KPIs using Pearson correlation coefficients and p-values. A positive correlation indicates that both indicators increase together, while a negative correlation shows that one increases as the other decreases. If p-value < 0.05, the relationship is considered statistically significant. Given the number of pairwise correlations analyzed, the results were interpreted with caution to avoid potential Type I errors. Emphasis was placed on the strongest and most consistent relationships among KPIs.

To ensure clarity and reproducibility, Table 1 presents the statistically significant correlation relationships between selected KPI indicators, including Pearson correlation coefficients and p-values.

Table 1: Correlation relationships between KPIs and their significance.

KPI	Compared KPIs	Correlation	P-value
KPI_3	KPI_5	-0.677	0.011
KPI_4	KPI_5	+0.594	0.032
KPI_4	KPI_7	+0.595	0.032
KPI_5	KPI_7	+0.612	0.017
KPI_6	KPI_9	-0.887	0.00005
KPI_7	KPI_8	+0.562	0.046
KPI_8	KPI_2	+0.656	0.015
KPI_8	KPI_9	-0.562	0.046
KPI_12	KPI_4	+0.928	0.000005
KPI_12	KPI_5	+0.640	0.019
KPI_12	KPI_6	+0.601	0.030
KPI_12	KPI_8	+0.571	0.038

The strongest positive correlation was observed between KPI_12 and KPI_4 (r = +0.928). KPI_12 also demonstrated strong relationships with KPI_5, KPI_6, and KPI_8, confirming its central role. KPI_4 was correlated with KPI_5 and KPI_7, while KPI_5 was correlated with KPI_7. The strongest negative correlation was identified between KPI_6 and KPI_9 (r = -0.887), reflecting opposing trends. KPI_8 stands out as an indicator associated with multiple dimensions of performance.

Figure 1 shows that the largest concentration of KPI indicators is observed in the economy, construction, and social sectors, whereas innovation-related indicators remain relatively limited. This suggests that the current KPI system is more developed in traditional administrative sectors and less mature in innovation-oriented areas. Overall, the findings indicate that the effectiveness of KPI-based evaluation depends not only on the number of indicators, but also on their strategic alignment, monitoring frequency, and sector-specific relevance.

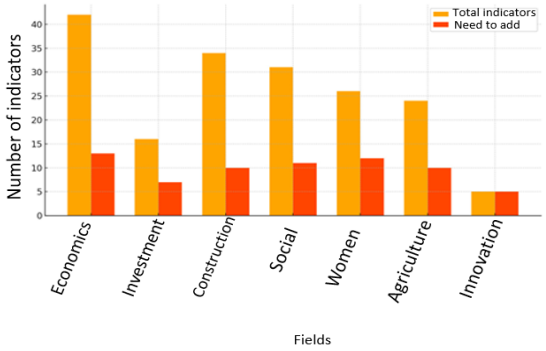

Figure 1: Distribution of KPIs by industry.

The analysis indicates that the effectiveness of the current KPI system is constrained by several structural factors, including weak alignment between indicators and strategic objectives, insufficient consideration of local socio-economic conditions, limited monitoring frequency, and inadequate integration of quality-related measures. These findings suggest that improving managerial performance evaluation requires not only statistical validation of indicators, but also stronger digital monitoring procedures and better adaptation of KPI frameworks to regional governance conditions.

This visual analysis enables decision-makers to identify the sectors where KPI systems need to be revised or improved (Table 2).

Table 2: Main factors influencing KPIs in assessing the performance of managerial staff of local government.

No	Factors	Proposal for improvement
1	The indicators were not developed using the "Chain" method.	Development at the republican, regional, and district (city) levels, depending on the country's strategy
2	The socio-economic potential of the district and the drivers of economic growth were not taken into account when developing the indicators.	In developing the indicators, the economic efficiency is expected to increase by approximately 10% through analyzing the district's socio-economic potential and drivers of economic growth.
3	The indicators are evaluated every six months.	According to foreign experience, conducting evaluations quarterly increases the accountability for achieving the indicators.
4	There is no monthly monitoring system for achieving the indicators.	Through a digitized 'work plan' system, the tasks are carried out and monitored quarterly by implementing the established indicators. In other words, it is not expected that the completion status of tasks will only be known at the end of each quarter; rather, the results are tracked at the end of every month

This table includes the main factors affecting the KPI indicators used to evaluate the performance of local government executives, as well as proposals for their improvement, allowing for a more precise, effective, and results-oriented assessment of executive performance.

During the evaluation process, there are a number of objective factors that influence efficiency, and a thorough analysis of these factors serves as an important basis for improving the system. In studies conducted at the Karshi District Administration, practical and statistical approaches were combined in the process of identifying and assessing these factors.

5 KPI-BASED DECISION-SUPPORT MODEL AND IMPLEMENTATION

5.1 Conceptual Model

The proposed decision-support model for evaluating the effectiveness of managerial staff in local government is based on a data-driven approach and integrates statistical analysis with performance management principles.

The model consists of several interconnected components:

- Input layer: data collected from social surveys, administrative records, and performance reports;
- Data processing layer: preprocessing and statistical analysis of data using descriptive statistics, factor analysis, and correlation analysis;
- KPI evaluation module: selection, validation, and prioritization of key performance indicators based on statistical significance and expert assessment;
- Analytical layer: identification of relationships among KPIs and determination of central indicators influencing overall performance;
- Output layer: generation of performance scores, analytical reports, and management recommendations;
- User interface: a digital dashboard for visualizing KPI performance and monitoring changes over time. The dashboard includes interactive features such as filtering by sector, time-series analysis, and automatic alerts when KPI values fall below threshold levels.

This conceptual model enables a systematic and objective evaluation of managerial performance and supports evidence-based decision-making processes in local government.

The proposed system can be implemented as a digital platform that integrates data collection, KPI evaluation, and monitoring functions. The platform supports real-time tracking of indicators and generates alerts when performance deviates from target values.

From the applied IT perspective, the proposed model can be implemented as a rule-based and data-driven software module integrated into a local e-government platform. The system collects KPI values from administrative databases and survey forms, preprocesses them, calculates indicator weights using statistical parameters, computes the overall performance score, and visualizes the results in a dashboard. This allows automated monitoring, threshold-based alerts, and evidence-based managerial decision-making.

5.2 System Architecture

To ensure the practical implementation of the proposed decision-support model, a three-layer system architecture is proposed.

Figure 2 illustrates the architecture of the proposed system. The proposed decision-support system is designed using a three-layer architecture:

- Data Layer-responsible for storing and managing KPI data collected from surveys, administrative records, and reporting systems.
- Processing Layer-performs data preprocessing, statistical analysis (factor analysis, correlation analysis), and calculates KPI weights based on statistical significance.
- Application Layer-provides a user interface (dashboard) for visualization, performance monitoring, and decision-support outputs.

This architecture ensures scalability, flexibility, and integration with existing e-government platforms, while transforming the proposed evaluation framework into a digital decision-support solution suitable for local public administration information systems.

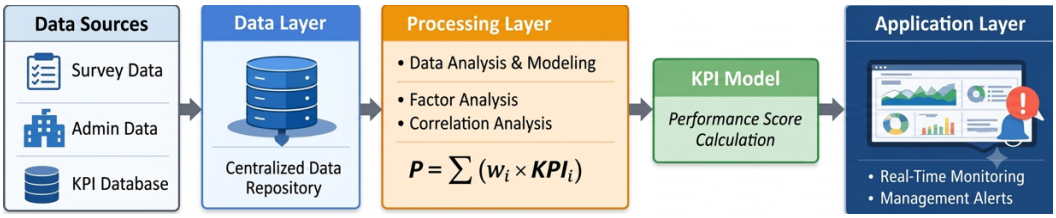

Figure 2: System architecture of the KPI-based decision-support model.

5.3 System Implementation

System Workflow

The system operates through the following computational pipeline:

1) Data Input: KPI data are collected from surveys and administrative systems.
2) Data Cleaning: missing and inconsistent values are processed.
3) Feature Selection: irrelevant KPIs are removed based on expert evaluation.
4) Statistical Processing: factor analysis and correlation analysis are applied.
5) Weight Calculation: KPI weights are assigned based on factor loadings.
6) Score Computation: overall performance score is calculated.
7) Output Generation: results are visualized through dashboards and reports.

Based on the proposed model, a digital decision-support system can be developed to enhance the effectiveness of KPI-based performance evaluation.

The system is designed to operate as a continuous monitoring platform and includes the following functional stages:

1) Data collection: integration of survey data, administrative indicators, and reporting information into a unified database.
2) Data processing: automated statistical analysis using software tools, including factor analysis and correlation analysis.
3) KPI monitoring: regular tracking of selected indicators on a monthly basis.
4) Performance evaluation: calculation of KPI-based performance scores for managerial staff.
5) Alert mechanism: identification of deviations from target values and generation of alerts for management intervention.

Example of Performance Score Calculation. To demonstrate the computational implementation of the model, an example of performance score calculation is provided. For a given managerial unit, the performance score can be calculated as follows:

$$P = (0.25 \times KPI\_12) + (0.18 \times KPI\_4) + (0.15 \times KPI\_5) + (0.12 \times KPI\_8) + \ldots \quad (2)$$

where the weights are derived from factor analysis and the selected KPIs are standardized before aggregation. This approach transforms empirical results into a quantifiable and automated evaluation mechanism.

6) Decision-support outputs include analytical insights, priority areas, and recommendations for improving performance.

The implementation of a digital dashboard allows real-time visualization of KPI dynamics and supports transparency and accountability in management processes. Central indicators, such as KPI_12 identified in the study, can be used as leading indicators to trigger timely managerial actions.

This approach transforms the traditional evaluation system into a dynamic, data-driven decision-support tool, contributing to the digitalization of public administration and improving overall management effectiveness.

6 CONCLUSIONS

This study demonstrated that KPI-based evaluation of managerial staff in local government can be improved through a statistically validated and digitally implementable decision-support model. Based on a survey of 153 respondents and expert-based selection of indicators, the study reduced the initial set of 184 KPIs to 76 statistically relevant indicators. Factor and correlation analyses confirmed the internal consistency of the selected KPI structure and identified central indicators, particularly KPI_12, as key elements of the evaluation system.

The findings also showed that the effectiveness of managerial performance evaluation depends on strategic alignment, sector-specific relevance, and regular monitoring of indicators. In particular, the results revealed that the current system requires stronger integration with local socio-economic conditions and more systematic digital monitoring procedures.

The main contribution of the study to applied IT lies in the formalization of KPI-based evaluation as a computational model and its transformation into a scalable digital decision-support framework. The proposed approach enables automated data processing, performance scoring, dashboard-based visualization, and evidence-based managerial decision-making in public administration.

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