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INTEGRATED METHODOLOGY FOR ASSESSMENT OF FINANCIAL ABILITY OF LOCAL BUDGETS

The article addresses the critical issue of ensuring the financial capacity of local budgets, a key factor in the sustainable socio-economic development of Ukraine's regions. The authors propose an integrated methodology for assessing the financial capacity of local budgets, emphasizing its incorporation into a digital system utilizing advanced technologies such as artificial intelligence (AI). Particular attention is paid to the use of coefficients in financial analysis, which ensures objectivity, comparability, and effectiveness of research. These coefficients, as quantitative indicators, enable a comprehensive analysis of budget revenues and expenditures, assessment of financial stability, self-sufficiency of communities, and evaluation of the efficiency of resource utilization. The study provides an in-depth analysis of the budget of the city of Irpin, highlighting trends in the financial stability of the community amidst a crisis caused by military conflict. The analysis revealed both strengths and vulnerabilities, showcasing the role of coefficients in rapid diagnostics of budget performance, identifying problematic areas, and formulating effective solutions for community recovery and development. The article also examines opportunities to adapt international practices, including the Urban Audit program in the European Union, Gender Responsive Budgeting in Sweden, and the Municipal Performance Measurement Program in Canada. The authors stress the need to create an AI-based automated system capable of not only analyzing financial indicators but also generating actionable recommendations for community development. The proposed methodology integrates automated systems with a coefficient-based approach to cluster communities by development level, offering targeted recommendations to improve their financial resilience. This innovation aims to enhance the efficiency of local budget management, ensure transparency in decision-making processes, and promote the socio-economic well-being of the population.
Keywords: regional development, clustering, coefficient analysis, financial capacity of the region, local budget, artificial intelligence.

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ІНТЕГРОВАНА МЕТОДИКА ОЦІНКИ ФІНАНСОВОЇ СПРОМОЖНОСТІ МІСЦЕВИХ БЮДЖЕТІВ

У статті досліджується проблема забезпечення фінансової спроможності місцевих бюджетів, що є важливим фактором сталого соціально-економічного розвитку регіонів України. Авторами запропоновано використання інтегрованої методики оцінки фінансової спроможності місцевих бюджетів та інтеграцією їх у цифрову систему із застосуванням сучасних технологій, таких як штучний інтелект. Особливу увагу приділено використанню коефіцієнтів у фінансовому аналізі, що дозволяє забезпечити об'єктивність, порівнянність і ефективність досліджень. Коефіцієнти, як кількісні показники, дають змогу глибоко аналізувати дохідну й видаткову частини бюджетів, визначати фінансову стійкість, рівень самодостатності громад, а також оцінювати ефективність використання бюджетних ресурсів. У статті наведено результати аналізу бюджету міста Ірпін, що дозволило виявити тенденції фінансової стійкості громади в умовах кризи, спричиненої військовими діями. Результати дослідження підкреслюють

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важливість використання коефіцієнтів для швидкої діагностики стану бюджету, визначення проблемних зон та формування ефективних рішень для відновлення й розвитку громад. Розглянуто варіанти адаптації міжнародного досвіду: програм Urban Audit у країнах ЄС, Gender Responsive Budgeting у Швеції, та Municipal Performance Measurement Program у Канаді. Наголошено на необхідності створення автоматизованої системи на основі штучного інтелекту, яка б не лише аналізувала фінансові показники, але й формувала рекомендації щодо розвитку громад. Запропонована методика сприятиме підвищенню ефективності управління місцевими бюджетами, забезпеченню прозорості прийняття рішень, а також поліпшенню соціально-економічного добробуту населення.

Ключові слова: регіональний розвиток, кластеризація, коефіцієнтний аналіз, фінансова спроможність регіону, місцевий бюджет, штучний інтелект.

Problem Statement. The socio-economic well-being of regions forms the foundation for sustainable development in Ukraine, particularly in the face of economic instability caused by the war. In these circumstances, regions face the urgent need to ensure financial independence, social stability, and economic efficiency. Achieving these goals requires the adoption of modern approaches to managing budget resources.

The analysis of budgetary indicators and the evaluation of the activities of budget managers are essential elements in ensuring the efficient use of local budget resources. This directly impacts the socio-economic well-being of regions. However, most communities in Ukraine encounter numerous challenges that complicate the implementation of these tasks. Key challenges include the lack of a unified methodology for analyzing budget indicators, the diverse and specific activities of individual institutions, restricted access to statistical data, and legislative deficiencies. These issues significantly affect the quality of managerial decision-making, hinder the formation of effective development strategies for communities, and reduce transparency in managing budget funds. Under such conditions, it is critical to implement a systematic approach that ensures accurate planning, rational organization, prompt control, and detailed analysis of income and expenditure.

Particular attention must be given to adapting analysis methodologies to modern conditions characterized by rapid changes, economic instability, and the growing role of digital technologies. Tools such as artificial intelligence (AI) and automated analysis systems can significantly enhance the effectiveness of managerial decisions.

Analysis of Recent Research and Publications. The efficient use of budget funds and the analysis of the socio-economic well-being of regions are actively studied by both domestic and foreign researchers. Internationally, standardized approaches such as Urban Audit in European Union countries, Gender Responsive Budgeting in Sweden, and data analytics tools like OpenGov in the United States are widely employed. These models aim to systematize data, enhance management transparency, and ensure social equity.

In Ukraine, researchers such as Ye.A. Ananieva, V.V. Volkova, S.A. Dyachenko, L.I. Katan, S.V. Kachula, T.A. Kolyada, N.I. Demchuk, D.K. Pavlova, O.S. Sokyryko, V.O. Miroshnyk, K.P. Nadochnyi, and others have focused on the effectiveness of local budgets. Their work emphasizes the need for integrated approaches to evaluating the financial independence of regions. However, most research has concentrated on specific aspects of budget policy without offering comprehensive solutions for assessing the financial capacity of communities.

At the same time, the practical implementation of automated systems for analyzing budget indicators remains underdeveloped. Existing systems often fail to consider the specificities of Ukrainian communities, necessitating the adaptation of international experiences and the development of a unified analysis methodology that includes financial, social, and economic aspects.

Research Objectives. The study aims to develop a unified integrated methodology for assessing the financial capacity of budget managers using modern data analysis technologies. This methodology seeks to optimize the allocation and use of budget resources, enhance transparency and accountability in local government operations, and promote balanced socio-economic development of communities. It also aims to create conditions for adapting best international practices to Ukraine's circumstances and provide tools for automated control and analysis of budget indicators. The research results are intended to improve managerial decision-making, formulate regional development strategies, and enhance the well-being of the population.

Presentation of Main Research Findings

The analysis of income and expenditure in local budgets forms the basis for the effective functioning of budgetary institutions and the rational use of financial resources. This process involves examining sources of funding for budget institutions, evaluating budget deficits or surpluses, analyzing structural shifts in financial indicators, and assessing the execution of income and expenditure plans. This approach enables substantiated managerial decisions and directs resources toward addressing the actual needs of communities.

Effective community management is impossible without comprehensive analysis of its socio-economic development indicators. This analysis should include the following aspects:

1. **Socio-Economic Indicators of Community Development:** Analysis of gross regional product (GRP) as a core indicator of the community's economic potential, employment levels, and average wages reflecting residents' well-being. It also includes poverty level assessments to gauge the scale of social issues. Additional focus should be placed on investment in fixed assets as an indicator of economic development dynamics, the state of transport, energy, and social infrastructure to evaluate living conditions and business activity, and the contribution of enterprises to community development.

2. **Budgetary Indicators:** Examination of local budget revenue sources, including tax and non-tax revenues. Particular attention is given to personal income tax (PIT), which indicates a community's dependence on this revenue source. The analysis of investment levels demonstrates the community's capacity to attract additional financial resources, while expenditure structure analysis assesses the efficiency of budget allocation across various sectors.

3. **Efficiency of Budget Resource Utilization:** This includes the evaluation of programmatic expenditures, effectiveness of targeted programs, capital investments, and general development expenditures. The aim is to determine whether budget funds are used according to planned goals and whether these goals align with the community's strategic objectives.

4. **Performance of Budget Managers:** This aspect examines the completeness of budget resource utilization, adherence to principles of rational and transparent

spending, and the timeliness of fund allocation. The assessment also considers whether expenditures align with the community's actual needs.

5. **Use of Transfer Funds:** The efficiency of inter-budgetary transfers and grants is evaluated in terms of their impact on the implementation of community development programs. This analysis determines the community's dependence on such funds and identifies opportunities for optimization.

6. **Community Competitiveness:** This is characterized by the community's ability to attract external investors and create conditions for business development. It considers economic and social factors such as employment levels, infrastructure development, and opportunities for implementing innovative projects.

7. **Gender Analysis:** Special attention is given to the equitable distribution of budget resources among various social groups. Gender analysis identifies how effectively the community's budget meets the needs of different population categories, promoting social equity and inclusive development.

To ensure accuracy and transparency in analysis, it is advisable to consolidate the above aspects into a unified system of integrated coefficients. These coefficients allow for the evaluation of the socio-economic condition of a community as a whole and enable comparisons with other communities. This approach facilitates the clustering of communities based on their level of development (depressed, developing, and successful communities).

Criteria for Clustering Communities

1. **Financial Capacity of the Community:** Includes the analysis of the performance of revenue and expenditure budgets, demonstrating the community's ability to meet its needs using its own resources. Dependence on intergovernmental transfers (subsidies and grants) is also evaluated to determine the degree of financial independence. Additionally, income and expenditure per capita are taken into account, reflecting the community's ability to meet basic social and economic needs.

2. **Activity of Local Self-Government Authorities:** Evaluates the number of projects implemented by the community over a year, considering their scale and impact on socio-economic development. Success in grant programs is analyzed, including the number of projects won, the volume of attracted funds, and the results of their implementation. The effectiveness of projects aimed at solving social problems, infrastructure development, and creating new economic opportunities is also studied.

3. **Gender Analysis:** Examines the equitable distribution of budgetary funds among various social groups, including women, men, children, youth, retirees, and other vulnerable categories. The analysis identifies imbalances in funding programs and projects intended to ensure social equality and inclusion. Special attention is paid to the integration of gender aspects during the development and implementation of budgetary programs.

4. **Comparative Analysis:** Involves benchmarking key community development indicators with those of other communities with similar demographic characteristics, scales of economic activity, and levels of infrastructure development. This enables the identification of the community's strengths and weaknesses, determining practices to adopt from leading communities, and forming cooperation directions to enhance development efficiency.

5. Efficiency of Budgetary Fund Utilization: Analyzes the transparency of budget management, including public disclosure of income, expenditures, and program outcomes. The organization of expenses and their alignment with approved budgets and planned goals are also examined. Adherence to the principle of rational expenditure is assessed through the evaluation of the real economic and social effects of the expenditures. The completeness of budget resource utilization and the efficiency of their use by final beneficiaries are evaluated.

Clustering communities based on these criteria provides an objective basis for analyzing financial capacity, identifying key problems in local budget operations, and formulating substantiated recommendations to improve efficiency. This contributes to enhancing transparency and objectivity in evaluations, while providing a necessary foundation for strategic regional development planning.

For analysis, a series of indicators has been proposed, summarized in Table 1, detailing the methodology for calculating coefficients to assess community financial capacity.

Table 1. Methodology for Calculating Coefficients to Assess the Financial Capacity of Communities, formulated by the authors based on [1, 2]

No	Indicator	Calculation Method
Coefficients for Evaluating the Financial Capacity of the Community's Budget Based on General Revenue Indicators of the Local Budget		
1	Revenue Base Stability Coefficient	$K_{pa} = PNmb / (Dmb)$
2	Financial Independence Coefficient	$K_{fs} = Dvmb / Dmb$
3	Budget Coverage Coefficient (Special Fund)	$K_{bp} = Dsf / Vsf$
OT – Official transfers; Dmb- Local budget revenues (including transfers); Dvmb - Local budget revenues (excluding transfers); PNmb – Tax revenues of local budgets; NNmb – Non-tax revenues of local budgets; Vsf – Expenditures of the special fund of local budgets; Dsf- Revenues of the special fund of local budgets.		
Coefficients for Evaluating the Revenue Structure of Local Budgets by Budget Classification		
1	Tax Revenue Coefficient	$K_{pn} = PNmb / Dmb$
2	Non-Tax Revenue Coefficient	$K_{nn} = NNmb / Dmb$
3	Target Fund Revenue Coefficient	$K_{cf} = D_{cf} / D_{mb}$
4	Official Transfers Coefficient	$K_{ot} = OT / D_{mb}$
5	Tax Self-Sufficiency Coefficient	$K_{ps} = MP / D_{mb}$
PN _{mb} – Tax revenues of local budgets; Dmb- Local budget revenues (including transfers); NNmb – Non-tax revenues of local budgets; Dvmb - Local budget revenues (excluding transfers); Nop – Revenues from capital operations of local budgets; OT – Intergovernmental (official) transfers; MP – Local taxes.		
Coefficients for Financial Stability of the Community Budget		
1	Grant Dependency Coefficient	$K_{dz} = S / D_{mb}$
2	Budget Stability Coefficient	$K_{sb} = OT / Dvmb$
D _{vmb} – Own revenues of local budgets (excluding transfers); OT – Intergovernmental (official) transfers; S – Subsidies to local budgets; Dmb- Local budget revenues (including transfers); Vmb - Expenditures of local budgets.		

The financial capacity of a local budget is a critical indicator of its stability and self-sufficiency. Table 2 presents the dynamics of coefficients characterizing various

aspects of the financial sustainability of Irpin's budget from 2020 to 2023. An analysis of the financial capacity of Irpin's budget reveals both positive and negative trends. However, these indicators must be evaluated in the context of extraordinary circumstances, particularly the war that began in February 2022. During the occupation between February and April 2022, the city suffered significant infrastructure destruction, and many residents were displaced. At the same time, following its liberation in late April 2022, and especially from the end of 2022, the city became a critical refuge for internally displaced persons, which increased the financial burden on the budget. Under these conditions, indicators such as reduced financial independence of the budget or a decline in the share of tax revenues can partially be attributed to the war, the destruction of the economic base, and migration processes.

Table 2. Calculation of Financial Capacity Coefficients for Irpin's Budget (2020–2023), compiled and calculated by the author based on [3]

Indicators	2020	2021	2022	2023
Revenue Base Stability Coefficient	0,74	0,72	0,59	0,52
Financial Independence Coefficient	0,75	0,73	0,60	0,53
Budget Coverage Coefficient (from Special Fund Revenues)	0,12	0,22	0,34	0,46
Tax Revenue Coefficient	0,74	0,72	0,59	0,52
Non-Tax Revenue Coefficient	0,009	0,009	0,006	0,012
Target Fund Revenue Coefficient	0,047	0,097	0,086	0,184
Official Transfers Coefficient	0,25	0,27	0,40	0,47
Tax Self-Sufficiency Coefficient	0,19	0,28	0,23	0,19
Grant Dependency Coefficient	0,04	0,05	0,20	0,13
Budget Stability Coefficient	0,34	0,37	0,67	0,89

The increase in the Budget Stability Coefficient from 0.34 in 2020 to 0.89 in 2023 demonstrates that the city of Irpin has managed to adapt to new conditions and find ways to maintain financial stability. The growing role of the Special Fund and revenues from Target Funds highlights the proactive actions of local authorities in attracting targeted financing for infrastructure restoration and social support. Specifically, since 2022, the Irpin community has been receiving considerable amounts of targeted assistance from international programs and funds. At the same time, the decline in the Tax Revenue Coefficient and the Tax Self-Sufficiency Coefficient requires local authorities to implement additional measures, such as stimulating economic activity, supporting business development, and creating conditions for the return of residents and the revival of entrepreneurship.

The crisis caused by the war also underscored the importance of using coefficient analysis as a tool for managing local finances. In complex conditions, analyzing indicators allows for rapid assessment of budget conditions, identification of weak points, and prompt responses to new challenges. For example, a low Non-Tax Revenue Coefficient points to the need for more efficient use of communal property and resources. The growth in revenues from Target Funds demonstrates the potential of targeted financing as a mechanism to support war-affected regions.

Coefficient analysis also provides vital information for adapting development strategies during wartime and post-war periods. In a situation where the city has become a haven for internally displaced persons, it is crucial to consider changes in the community's social structure, the need for financing social services, and infrastructure recovery. Coefficients help not only assess the impact of these changes but also build a long-term strategy for recovery and development. Regular use of such analysis will enable local authorities to ensure financial stability even in times of external crises.

Working with such a large number of indicators requires the state to establish a unified digital database incorporating data from local government bodies, the State Statistics Service, Social Insurance, the Tax Service, Customs, and others. At the same time, implementing a coefficient approach faces two primary challenges: the complexity of calculating numerous indicators and consolidating them into unified coefficients, and the human factor. The responsibility for working with coefficients, based on the structure of local government bodies, should be assigned to economic departments.

However, local government bodies may intentionally not adhere to fair calculation methodologies to manipulate indicators, cover up instances of abuse of power, or neglect official duties. To counter this, it is advisable to develop an AI-based system that independently calculates indicators based on data provided by state services across various sectors (local government bodies, the State Statistics Service, the Tax Service, etc.). This system should include mechanisms for verifying data accuracy, such as cross-verifying data from multiple sources, cross-validation methods, and automated checks for discrepancies or anomalies in the data.

The creation of a unified database with digital algorithms for calculating, evaluating, analyzing, and comparing indicators using AI would minimize the negative influence of the human factor, eliminate the need for additional funding for training economic department employees or staff expansion, and automate and optimize analytical processes. AI integration would ensure objectivity and transparency in data analysis. Such a system would automatically account for economic, political, and social factors at both the national and global levels (e.g., inflation, legislative changes, regional policies), which influence community development without requiring additional methodological recommendations for local government bodies. This would enable swift adjustments to analytical data, increasing their relevance.

It is also worth noting that economic departments under local government bodies often lack the capacity to conduct quality analytical forecasting due to insufficiently trained personnel. An AI-based analytical system would allow local governments to monitor forecast dynamics daily and respond in a timely manner (e.g., forecasting budget revenue levels influenced by employment changes over the next five years). The Ministry of Regional Development of Ukraine should oversee the development and monitoring of calculation methodologies and forecasting for this system.

Based on processed data, the system would categorize communities according to the criteria mentioned earlier. Dividing communities into categories (depressed, developing, successful) would provide a clear understanding of each community's condition and facilitate the formation of targeted recommendations. For instance, the Ministry of Regional Policy, regional, and district councils would be able to iden-

tify causal factors of community development problems and assist in resolving them remotely. It would be appropriate to complement such a system with basic recommendations, case studies of successful foreign experiences, and examples from domestic communities (e.g., increasing community investment attractiveness, improving urban infrastructure, or enhancing budget efficiency). These recommendations, generated by AI based on indicator analysis, would provide local governments with ideas and directions for community development and problem-solving.

Such systems are already successfully implemented in other countries. The European Union prioritizes the systematization and monitoring of development indicators through the Urban Audit initiative. This program covers more than 800 cities across Europe, collecting data on quality of life, including social, economic, and environmental aspects. The use of standardized indicators allows not only for comparisons between different cities but also for making informed strategic decisions. The information provided by Urban Audit is critical for local governments as it reflects the real state of community development and helps identify vectors for development and current problems.

In Germany, the Kommunale Finanzen tool is actively used to analyze community financial stability. This system employs integrated coefficients such as tax capacity, expenditure efficiency, and investment levels. In Bavaria, for example, this system has been used to develop recommendations for optimizing budget planning in small communities, significantly improving financial stability in rural areas.

Sweden is a pioneer in implementing gender analysis during municipal budget planning. Gender Responsive Budgeting ensures consideration of the needs of various social and gender groups, promoting social equity. This approach has become mandatory in many regions and has proven effective in addressing social and budgetary issues.

The United States provides an example of active adoption of analytical platforms under the Data-Driven Governance program. Municipalities like New York use OpenGov or GovTech to assess budget efficiency. These systems enable real-time analysis, optimize expenditures, and ensure transparency in government operations. For instance, New York has reduced the cost of public service delivery by leveraging large datasets for need prediction.

Canada's Municipal Performance Measurement Program (MPMP) is based on evaluating the efficiency of municipal services through standardized indicators, including service costs, resident satisfaction, and infrastructure quality. This model enables municipalities to allocate resources rationally based on community needs. MPMP has been instrumental in reducing budgetary disparities among communities in Ontario with varying levels of development. This program exemplifies how an integrated analytical approach can assist in making informed managerial decisions.

Conclusion and Prospects for Further Research. Integrating coefficient-based data processing of regional development through AI systems will enable Ukraine to enhance community management quality, promote transparency, and ensure objective analysis. For instance, implementing platforms similar to Urban Audit will standardize data and unify approaches to evaluating community living standards. Applying gender analysis mechanisms will ensure social equity and targeted resource allocation. Moreover, using efficiency assessment tools like MPMP will form the foundation for

more rational planning and expenditure control in communities. Incorporating these elements into the national regional development system will be a significant step toward improving regional competitiveness and population well-being.

The proposed introduction of AI into local budget analysis, which encompasses coefficient calculation, community clustering by development level, and recommendation generation based on large datasets, is central to creating an effective approach to ensuring socio-economic regional well-being. A critical aspect is establishing a unified statistical database and a unique digital system that, leveraging coefficient analysis, not only monitors budget indicators but also generates recommendations for enhancing community financial capacity. This innovative solution combines advanced technologies with practical tools for local governance, contributing to regional competitiveness and the population's improved well-being.

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