

## **pim-pam.net Geospatial Planning and Budgeting (GPB) Tools**

### **Local Development Tracker (LDT) Application Serbia LIID Project Uptake**

*This Version: June 07, 2026*

#### **Overview**

1. The Local Infrastructure and Institutional Development (LIID) project provides a crucial source of public investment financing for municipal development across Serbia (World Bank, 2023). The LIID provides a capital grant envelope to each of the 148 Local Self-Government (LSG) units that meet certain prerequisites, including the submission of one or more project proposals against this envelope. Since the first LSG completed this stage in December 2023, just over a quarter of the LSGs met this stage based on early 2026 data.
2. Empirically understanding the specific municipal characteristics and socio-economic factors that determine both the likelihood of participation and the progress of implementation can inform the design and sequencing of incentives and support to help all governments better realize Local Economic Development (LED) outcomes over time. This insight allows policymakers to identify gaps between intended policy reach and on-the-ground realities, ensuring that development funds are accessible to the populations that need them most, rather than only to those with the fastest administrative capacity. The analysis also provides for a preparatory empirical anticipated Implementation Completion Review (ICR) of LIID by 2028, and possible LSG support targeting under a possible LIID 2.0 follow-up.

## Executive Summary

3. Our analysis utilizes the full GPBP Data Cube—specifically deploying 3 macro Composite Scores (Infrastructure, Prosperity, Livability) and 25 granular Sub-Scores (e.g., Road Density, Waste Disposal Gap)—to map exactly what drives municipal participation in the LIID project. The analysis is supplemented with a panel of additional available administrative and statistical data for Serbia. Serbia's Ministry of Finance Local Fiscal Fisk-scoring File (see Annex 1). We further supplement this with an updated curation and analysis of administrative and statistical measures supported by the World Bank (Delibašić, Radovanović, & Vukanović, 2023). This exercise was focused on internal migration measures but has now been extended to encompass broader efforts in local economic development and job creation. This analysis applies reproducible analysis principles (see Box 1) and builds on the net Geospatial Planning and Budgeting (GPB) Local Development Tracker (LDT) Tool (Box 2).
4. The preliminary findings suggest that a municipality's likelihood of participating and the extent of its participation are associated with foundational infrastructure and baseline prosperity. High general infrastructure needs and low prosperity LSGs show some signs of lagging, as notional financial need does not automatically translate into administrative speed. Notably, the results distinguish between two dimensions of fiscal capacity: while the Own Source Revenue Rate is not statistically significant, Self-Financing Capacity — a composite measure of operating surplus, liquidity, and investment headroom — is a significant positive predictor of uptake. This suggests that what drives administrative speed is not the breadth of a municipality's revenue base per se, but whether it has the fiscal breathing room to act. This finding is compounded by the broader fiscal picture: data from the Ministry of Finance indicate that 130 of 148 LSGs carry overdue operating arrears, and approximately 72% fall below the "normal" threshold on self-financing capacity, pointing to widespread fiscal stress as a structural constraint on LIID readiness.

### **Box 1. *pim-pam.net* Reproducible Analysis**

The *pim-pam.net* GPB tools are committed to offering reproducible analysis methods to inform better policymaking, particularly for improved annual and medium-term budgeting and job creation. All analyses are therefore made available online as Google Colab Notebooks in Python. Whenever possible, all analyses are conducted using open-access data. Is the analysis based on restricted access data sources? This is then made explicit, as well as the terms by which the data is used. The analysis can typically be replicated using free-tier compute and Application Programming Interface (API) resources, for both Machine Learning (ML) and Generative AI insights. If for fee APIs are required, this is made explicit in the workbook, together with modalities by which developing country counterparts could gain access to resources to replicate, scale, and sustain demonstrated analysis use cases in their own contexts.

### **Box 2. *pim-pam.net* Geospatial Planning and Budgeting (GPB) Local Development Tracker (LDT) Tool**

The *pim-pam.net* GPB Local Development Tracker (LDT) tools generate composite measures of SNG benchmarks for Prosperity, Livability, and Infrastructure (World Bank, 2025a). These, in turn, are generated by a country's best available set of sub-indicator(World Bank, 2025b). The GPB LDT composite-level and sub-indicators can be used to explore further possible correlates, including those drawn from national administrative and statistical data sources (e.g., own source revenue mobilization or existing use of market based financed for public infrastructure)

## Geographic & Temporal Context

5. The LSG of VALJEVO is listed as the frontrunner in its LIID financing access. Figure 1 maps uptake, while Figure 2 shows the growing share of LSGs that formalized LIID projects over time. The question for empirical analysis is what LSG characteristics are associated with uptake to date (1/0), and with that sample, furthermore, the speed of uptake (days from the Valjevo).

**Figure 1. Geographic Distribution showing the number of lead days it took for municipalities to sign their first Grant Agreement.**

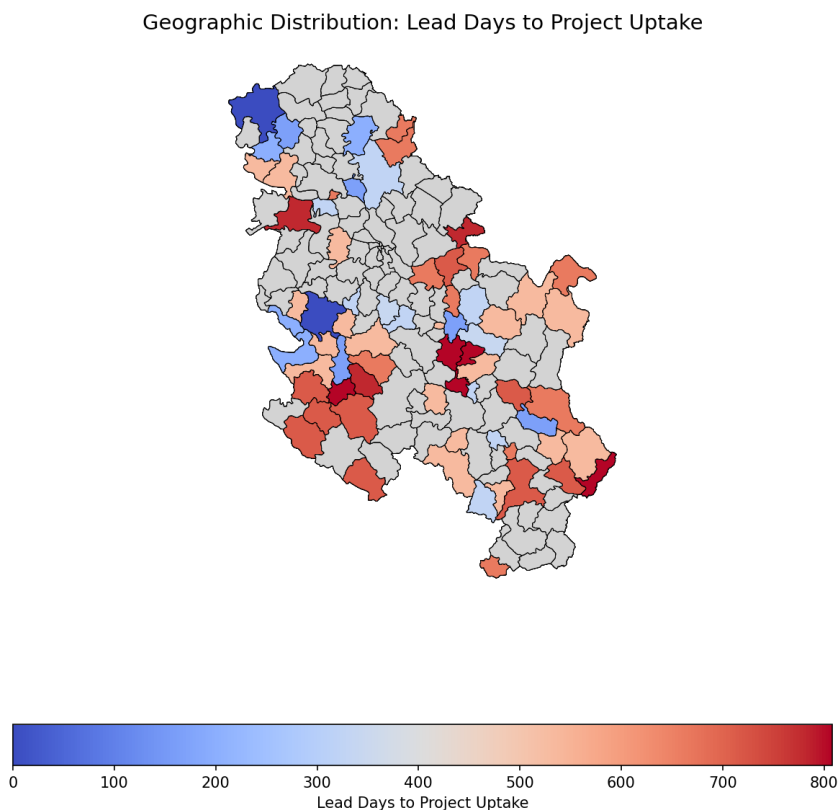
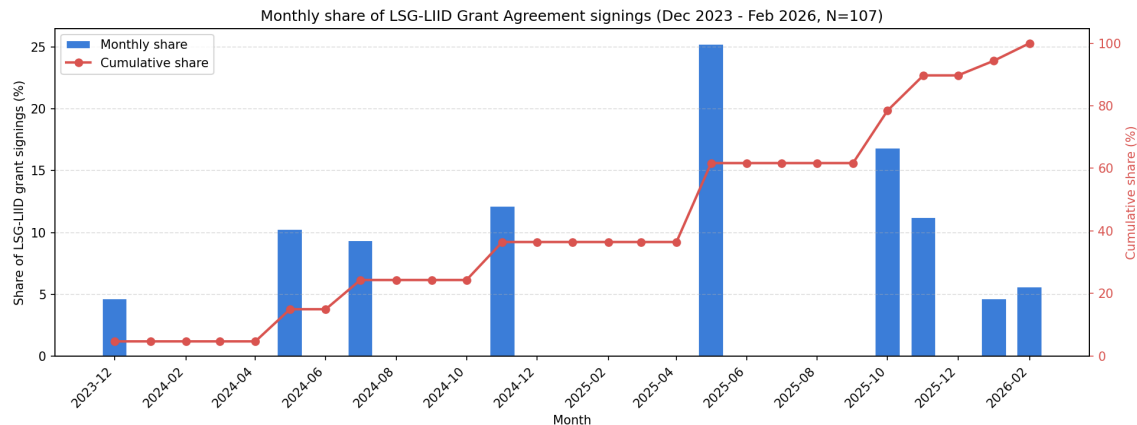


Figure 2. Timeline showing the monthly and cumulative share of Grant Agreement signings.



Analytical Framework & Data Sources

6. This analysis uses a Discrete-Time Hazard Model (Survival Analysis) to estimate the probability that a municipality will sign the grant agreement in any given month. By building a unit-month panel tracking every LSG across calendar time until they sign, this model cleanly avoids the right-censoring bias that plagues standard regressions (i.e., failing to recognize that a municipality that hasn't signed yet is still 'at risk' of signing tomorrow). The baseline model controls for Size (Population Proxy), Urbanization (Luminosity per Area), Own Source Revenue Rates, and Access to Market-Based Finance. It is worth noting that the Own Source Revenue Rate used as a baseline control reflects the MoF fiscal risk scoring definition, which includes shared revenues assigned to LSGs alongside genuinely discretionary local revenues. As discussed further in Annex 2, this measure tends to overstate effective fiscal autonomy. Future iterations of this analysis may benefit from a narrower definition restricted to revenues over which LSGs exercise genuine rate and base discretion — primarily property tax and local fees and charges. Similarly, Access to Market-Based Finance is proxied here by the MoF's debt service and payment burden indicators; it should be interpreted as a measure of existing debt obligations rather than borrowing capacity, since — as Annex 2 shows — the majority of Serbian LSGs are effectively absent from credit markets rather than overleveraged.

Table 1. pim-pam.net GPB Serbia LIID Analytics Data

| Collection | Description |
|------------|-------------|
|------------|-------------|

|                                                       |                                                                                                                                                                       |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GPB Local Development Tracker (LDT) Country Data Cube | SNG level indicators and sub-indicators for measures of local Prosperity, Livability, and Infrastructure (World Bank, 2025b). Level of focus is Serbia is LSG (N=148) |
| LSG Local Fiscal Risk Database                        | Increase measures of own source revenue and debt                                                                                                                      |
| GPB LED Country Data Cube (CDC)+                      | Enhanced version of initial baseline analysis conducted by Delibašić, et al. (2023), including LIID PIU data                                                          |

Source: World Bank, MoF, LIID PIU, Statistics Agencies

## Detailed Predictive Findings

7. The tables below highlight which factors truly move the needle. A positive coefficient means the attribute increases the hazard rate (i.e., making them sign faster/more reliably). We strictly filter the granular sub-scores to only display those meeting the 95% confidence threshold. For simplicity, we used LSG attributes available for 2025, rather than a panel for

"Note: This unified model consolidates both the likelihood of signing and the speed of signing into a single metric. A positive Hazard Coefficient indicates factors that make signing both more likely and faster, while a negative coefficient indicates bottlenecks that stretch the timeline out or prevent signing altogether. For a more detailed guidance on how to read these model results, please refer to Annex 1."

**Table 2. Baseline Controls Impact on Signing Timeline**

| Baseline Control Variable       | Significant at 95%? | Hazard Coefficient |
|---------------------------------|---------------------|--------------------|
| Size (Population Proxy)         | No                  | -0.0051            |
| Urbanization (Luminosity Proxy) | No                  | 0.0010             |
| Own Source Revenue Rate         | No                  | -0.2347            |
| Self-Financing Capacity         | Yes                 | 0.0966             |

**Table 3. Composite Scores Impact on Signing Timeline**

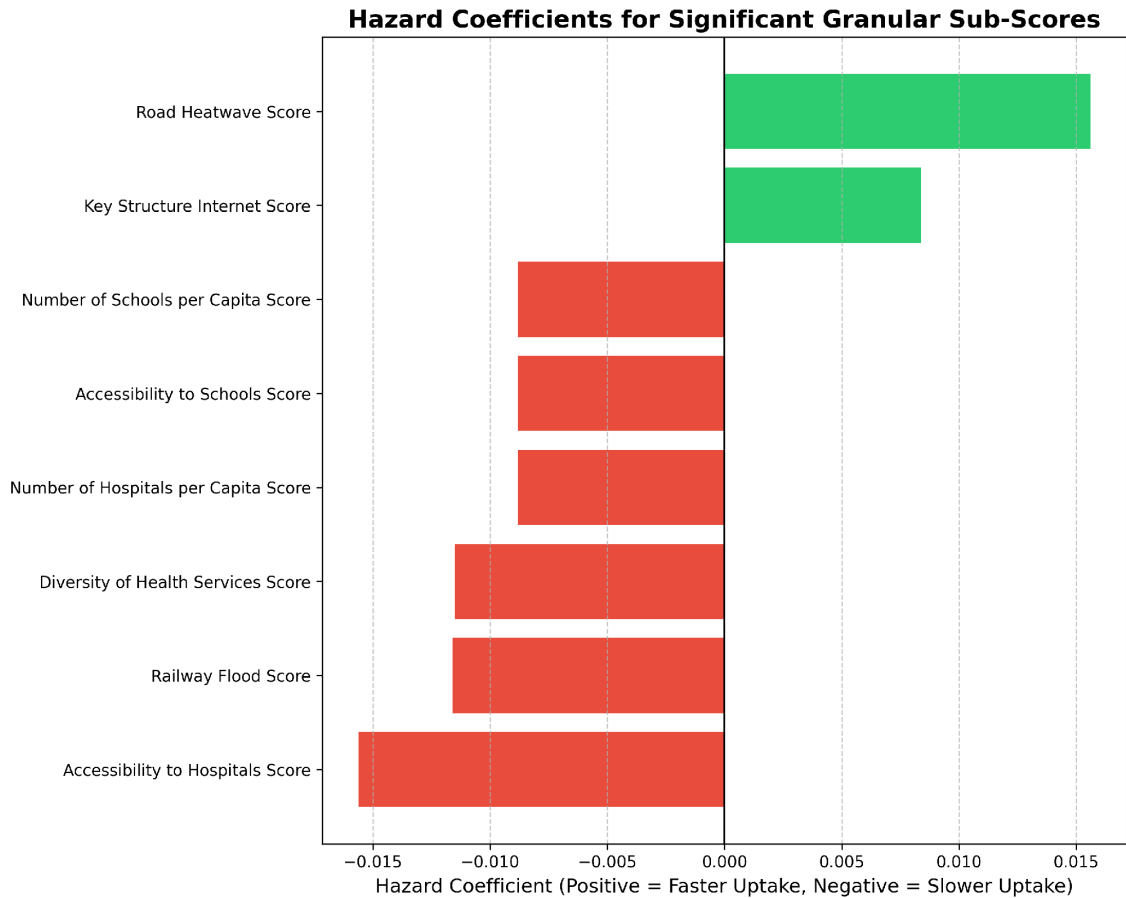
| Composite Score      | Significant at 95%? | Hazard Coefficient |
|----------------------|---------------------|--------------------|
| Prosperity Score     | No                  | 0.0058             |
| Infrastructure Score | Yes                 | -0.0310            |
| Livability Score     | No                  | 0.0046             |

**Table 4. Granular Sub-Scores Impact on Signing Timeline**

| Granular Sub-Score                   | Significant at 95%? | Hazard Coefficient |
|--------------------------------------|---------------------|--------------------|
| Key Structure Internet Score         | Yes                 | 0.0084             |
| Railway Flood Score                  | Yes                 | -0.0116            |
| Road Heatwave Score                  | Yes                 | 0.0156             |
| Accessibility to Hospitals Score     | Yes                 | -0.0156            |
| Number of Hospitals per Capita Score | Yes                 | -0.0088            |
| Diversity of Health Services Score   | Yes                 | -0.0115            |
| Accessibility to Schools Score       | Yes                 | -0.0088            |
| Number of Schools per Capita Score   | Yes                 | -0.0088            |

8. The negative and significant coefficient on Infrastructure Score deserves interpretation. One might expect that municipalities with greater infrastructure deficits would move faster to access available financing. The opposite pattern likely reflects the compounding effect of administrative and fiscal stress: municipalities with the greatest infrastructure gaps are often also those with the weakest administrative capacity, highest arrears burdens, and most constrained operating balances — precisely the conditions that slow project preparation and grant agreement completion. In other words, need and readiness are not the same thing, and the data suggest they are negatively correlated in the Serbian LSG context. This reinforces the case for targeted pre-investment support to the most infrastructure-deficient municipalities.

**Box 3. Hazard Coefficients of Significant Granular Sub-Scores.** Green indicates factors driving faster uptake, red indicates factors driving slower uptake.



## Future Works & Next Steps

9. The current analysis is intended as an initial discussion that can be further refined based on methodological approaches and data. First, panel-based approaches may consider lead and lag effects. For example, only after a medium-term track record of increasing OSR can an LSG demonstrate greater readiness and job outcomes. Second, the pim-pam.net GPB LDT has created a baseline of all available LSG Strategies and Budgets in Serbian and the best available English Translation. Using new AI techniques, this can also be further assessed for readiness measures. At this stage, the baseline measures the coverage and comprehensiveness of the strategy documents. Generative AI distills possible linkages and alignment with LDT Prosperity, Infrastructure, and Livability indices, LIID, and job outcome measures. Finally, the exercise can be used for more strategic primary data collection, including special surveys.

### ***Do different fiscal variable specifications, such as OSR or debt finance, matter at all for uptake?***

10. In addressing this question, future analysis should distinguish between at least three fiscal dimensions that the current baseline conflates: (i) OSR effort — the degree to which municipalities are actively collecting revenues relative to their potential, controlling for economic base; (ii) liquidity and operating surplus — the actual fiscal headroom available for project preparation and co-financing; and (iii) creditworthiness — the combination of clean payment record, operating surplus, and stable revenue base that determines access to market finance. Disaggregating OSR into its main components — particularly property tax, shared revenues, and fees and charges — would further sharpen the analysis, since these have different implications for fiscal autonomy, enforceability, and long-term sustainability.

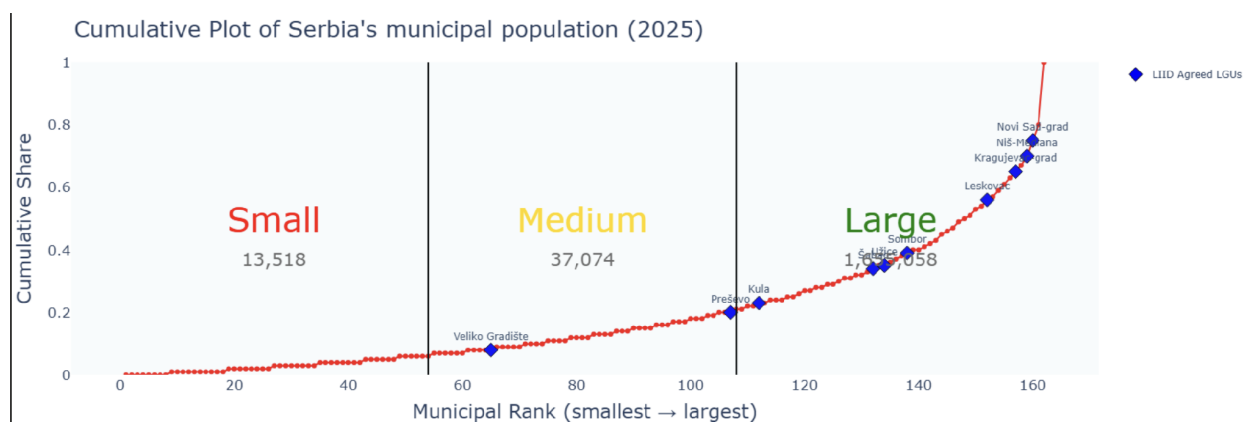
### ***What is the current perception across Serbian LSG of public infrastructure gaps and financing options?***

11. The European Investment Bank (EIB) conducts a periodic assessment of 1,000 LSGs across EU-27 settings (EIB, 2025; Sinnott, 2025). Going forward, it would be useful to extend this approach to LSGs in Serbia and beyond, in other Enlargement and Eastern Neighborhood (DG ENEST) pre-accession settings. The existing survey is quite short and can easily be administered to heads of finance and infrastructure at the LSG level, who work day-to-day with mayors. This could enrich the profiles and typologies of LSGs to better support targeting.

## What other quantitative and qualitative data can be leveraged to enhance SNG targeting and support?

12. Beyond establishing an initial LSG data analytics and visualization (DAV) baseline from global big data and selected administrative and statistical measures, the GPB LDT has also been set up to process information using Generative AI. The GPB LDT has established a database of all current LSG local development plans and annual budgets. This allows tracking of how these documents have evolved over the life of the LIID (i.e., since 2023) and which show the highest apparent comprehensiveness. The GPB LDT AI analysis also provides an SNG Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis based on the indicator, strategy, and budget analyses. This analysis outlines possible methods for enhanced targeting and/or focus group analysis.
13. **The SNG level across the EU-27 and the wider Eastern Europe & Central Asia (ECA) region is characterized by significant numbers and heterogeneity.** Central authorities and project design, therefore, always face a challenge of going wider or deeper in their support. The LIID stands out for providing wide support to the full spectrum of 148 LSGs in Serbia. This also provides a very valuable platform, a birdseye view of LSG progress and challenges. **Many LSG in Serbia is often quite small in terms of population.** Two-thirds of LSGs have less than 40 thousand inhabitants. Local ePIM design support workshops (see DS Consulting 2025) have to date worked mainly with large-scale LSGs (upper tercile per Figure 3). These will tend to have the larger projects (including those over Euro 2 million that fall under national PIM guidelines). However, this raises the question as to what can be done to better support the tail of small and potentially further lagging LSGs.

Figure 3. Serbia LGU Sizes



14. **Outcome-oriented SNG typologies provided for a way of better structuring “wholesale” versus “retail” support to LSGs at the country level.** While each LSG is indeed special, clusters or groups may share attributes that motivate a more collective approach to

approaching and supporting them. A large number of groupings can have diminishing returns, while a manageable set can help focus the central actors, such as Ministries of Finance. Delibašić et al. (2023) provide an early example of this approach using AI and Machine Learning (ML), focused on internal migration outcomes. From a policymaker and program implementation perspective, 3-7 categories are likely to have the greatest impact on decision support. These ideally would explain status and outcomes (e.g., jobs trends, classifications by low-high prosperity, infra and livability scores) by actionable measures, as some have been identified here. The initial LIID analysis presented here is a first step to operationalize this approach, including by updating relevant GPB CBD data inputs with the counterparts.

- Example impacts of any variables included in baseline GPB LED Country Data Cube (CDC)+ for Serbia
- Identify specific further data collection that could be prioritized by the Serbian Authorities and the LIID PIU?

## Annex 1. Model Selection Rationale

### Model Choice: Unified Survival Analysis

To evaluate the engagement of local governments (LSGs) with the LIID program, we transitioned away from a traditional two-step approach (which previously modeled 'Did they sign?' and 'How long did it take?' separately). Instead, both questions are now handled simultaneously in a unified Discrete-Time Hazard Model (Survival Analysis).

By tracking each municipality dynamically across calendar months in a 'unit-month panel', the model successfully accounts for right-censoring. This means that municipalities that have not yet signed are treated correctly as still being 'at risk' of signing in the future, rather than being misclassified as outright failures.

### Interpreting the Coefficients

In this model, the outcome variable is binary (0 or 1) representing whether an LSG signed the agreement in a given month.

- A **positive coefficient** means that a higher score increases the likelihood of signing in any given month, meaning the municipality tends to sign **faster** (it takes less time).
- A **negative coefficient** means a higher score decreases the monthly likelihood of signing, meaning the municipality tends to take **longer** to sign.

The model relies on a statistical technique designed specifically for time-based events (a discrete-time hazard model). It predicts the probability of a municipality signing the agreement in any given month, using robust error-checking to ensure accuracy. The baseline model strictly controls for foundational factors: Size (Population Lit Score proxy), Urbanization (Luminosity per Area proxy), and two fiscal-capacity measures (Own Source Revenue Rate and Self-Financing Score). The composite and granular sub-scores are then tested individually on top of this baseline to isolate their specific impacts.

For full reproducibility of this model, please refer to the accompanying Colab/Jupyter Notebook: [LIID Serbia - Attributes of LIID Uptake.ipynb](#)

LIID Serbia - Attributes of LIID Uptake.ipynb

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**GPB Tools**

Geospatial Planning & Budgeting Platform (GPBP)

Local Development Trends (LDT)

This notebook is part of the World Bank's Geospatial Planning & Budgeting Platform (GPBP). It leverages the Country Benchmarking Database (CDB) or "country data cube", a standardized, country-agnostic data infrastructure designed to integrate various socio-economic, environmental, and institutional indicators. The GPBP approach allows for scalable, cross-country and sub-national analytics.

Overview: Attributes Associated with LIID Uptake

Data Introduction

The analysis relies on three primary data layers:

- GPBP Country Data Cube:** Standardized socio-economic and demographic indicators for Serbian Local Self-Governments (LSGs).
- Local Data:** The LIID Signed Grant Agreements (GA) dataset, detailing project approvals, sectors, and financial allocations at the municipal level.
- World Bank Data / Additional Sources:** Macro-fiscal context, infrastructure access, or global benchmarking indicators mapped to the country data cube.

## Annex 2. Local Own and Market-Based Finance Access

**The availability of own-source revenues and the use of market-based finance can serve as an important pillar for sustainable public infrastructure provision and dynamic development.** In the fiscal decentralization literature, the conceptual line between own-source and shared revenues is drawn by control rather than by where the money is collected. Own-source revenues are those over which the local government exercises discretion over the rate and/or base — giving it a genuine fiscal lever and a stake in its local economy — whereas shared (ceded) revenues are levied, defined, and administered by the central government and merely apportioned to localities by a nationally prescribed formula. On this criterion, the public-finance literature treats shared revenues as intergovernmental transfers in substance, even where national charts of accounts record them as "own" revenues, because the locality cannot alter them at the margin. Consequently, measures that count shared taxes as local revenue tend to overstate effective fiscal autonomy (Bahl & Bird; OECD "tax autonomy" framework) (Bird, 2010; OECD & UCLG, 2022). Excessive use of debt can increase fiscal risks for the national and sub-national levels.

**The Serbia MoF used two headline indicators to classify fiscal risks each classifying units as *Normalno* (normal), *U riziku* (at risk), or *Pod nadzorom* (under supervision).** The two headline indices, each classifying units as Normalno (normal), U riziku (at risk), or Pod nadzorom (under supervision): Index 1 – Self-financing capacity: gross operating balance, own-source revenue share, investment intensity, cash balance. Result: 41 normal, 30 at risk, 77 under supervision — i.e. ~72% of units fall below "normal" on their ability to fund themselves. Index 2 – Payment burden: debt-service coverage, interest burden, short-term liabilities vs. current revenue. Result: 95 normal, 27 at risk, 26 under supervision.

**The MoF data suggests that LSG access to market-based finance is thin, and creditworthiness is the binding constraint.** 83 of 148 units (56%) carry zero debt service — they are essentially absent from credit markets, not over-borrowed. Where debt exists it's light: median interest burden 0.03%, median short-term-liabilities-to-revenue 4%. But 130 of 148 units carry overdue operating arrears — the real liquidity problem is unpaid bills, not loans. The gross operating balance (the surplus that services debt) averages only ~9% and is negative for some units (e.g. Arandelovac -5%), meaning many municipalities don't generate the recurring surplus a lender would require. The implication: the barrier to market finance isn't appetite or existing leverage — it's that most units lack the operating surplus, clean payment record, and own-revenue base that make them bankable. Six units (Batočina, Doljevac, Kučevo, Novi Pazar, Jagodina, Žitorađa) are U riziku on both indices; Novi Pazar stands out with short-term liabilities at ~300% of current revenue.

**This point deserves emphasis: the 56% of LSGs carrying zero debt service should not be read as a sign of fiscal prudence or available borrowing headroom.** In most cases, it reflects effective exclusion from credit markets — these municipalities are not under-borrowing by choice, but are not bankable on current fundamentals. The dominant fiscal constraint is not debt but arrears: 130 of 148 LSGs carry overdue operating obligations, meaning their cash flow is already committed to unpaid bills rather than to debt service or new investment. Any theory of change that assumes municipalities can access market finance once they improve their OSR must therefore address the arrears stock, the operating surplus gap, and the creditworthiness deficit simultaneously — not treat them as sequential steps. These findings are discussed in the context of the main predictive results in the Detailed Predictive Findings section above.

A theory of change for LED that suggests **stronger own-source revenue (especially property tax) → larger operating surplus → creditworthiness → access to market finance is current limited in Serbia.** The data shows that chain is broken at the first link for most Serbian municipalities. Breaking the chain at the first link — weak OSR effort and low operating surpluses — has a cascading effect: without a stronger revenue base, municipalities cannot build the surplus that lenders require, and without creditworthiness, they cannot access

the market finance needed to supplement grant-financed investment. This points to a sequenced support agenda: first, improve OSR administration and enforcement to build a sustainable revenue base; second, use improved operating balances to establish a track record; and third, facilitate access to market-based instruments for municipalities that have demonstrated fiscal discipline. LIID and any successor operation would need to position itself explicitly within this sequence, either as a fiscal capacity-building intervention at step one, or as a bridge financing instrument for municipalities already at step two.. Focus groups with LSG in Serbia suggest that public investment and services financing is often linked to local state-owned enterprises (World Bank, 2025a).

x

## Annex 3: Mapping of Granular Variables to Composite Pillars

pim-pam.net GPB Serbia LED Catalog

[https://docs.google.com/spreadsheets/d/1-0vS\\_dp2uoXP3sItD197C\\_knGG-uasdp/edit?gid=692761048#gid=692761048](https://docs.google.com/spreadsheets/d/1-0vS_dp2uoXP3sItD197C_knGG-uasdp/edit?gid=692761048#gid=692761048)

The three main composite scores (Prosperity, Infrastructure, and Livability) under GPB LDT V0.7 are built from the following granular sub-scores listed below. As part of the release of V1.0, the team is calibrating the selection and group of indicators to best align to conceptual clarity and best available measures.

### 1. PROSPERITY PILLAR

- Luminosity Score
- Luminosity per Capita Score
- Luminosity per Area Score
- Area Lit Score
- Population Lit Score

### 2. INFRASTRUCTURE PILLAR

- Key Structure Internet Score
- Mobile Internet Score
- Key Structure Internet Access Score
- Railway Density Score
- Road Density Score
- Railway Flood Score
- Road Flood Score
- Railway Heatwave Score
- Road Heatwave Score
- Accessibility to Hospitals Score
- Number of Hospitals per Capita Score
- Diversity of Health Services Score
- Accessibility to Schools Score
- Number of Schools per Capita Score

- Diversity of Schools Index Score

### 3. LIVABILITY PILLAR

- CO2e-Emissions Score

- Methane-Emissions Score

- Air Quality Score

- Waste Disposal Score

- Waste Disposal Gap Score

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