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SISTEM INTEGRACIJE PROSTORSKIH PODATKOV ZA VREDNOTENJE TRAJNOSTNE UČINKOVITOSTI SLOVENSКИH SOSESK IN NASELIJ

DATA INTEGRATION FRAMEWORK FOR THE ASSESSMENTS OF THE SUSTAINABLE EFFICIENCY IN SLOVENE NEIGHBOURHOODS AND SETTLEMENTS

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IZVLEČEK

v raziskovalnem projektu predlagamo razvoj novih metodologij za integracijo, optimizacijo in analizo prostorskih podatkov, ki so pomembni kot podpora odločanju pri trajnostni prenovi in optimizacijskih ukrepih v slovenskih soseskah in naseljih. Predlagani projekt gradi na izsledkih in delu predhodnega raziskovalnega dela, v katerem smo zasnovali sistem vrednotenja trajnostne učinkovitosti sosesk na osnovi modularnega sistema kazalcev in kriterijev ter povezane metode interpretacije vrednosti. Medtem ko je predhodna raziskava pretres trajnostne učinkovitosti in kvalitete sosesk obravnavala predvsem sistemsko-holistično, pa v nadaljevanju fokus zožujemo na specifične vidike trajnosti in kakovosti, in sicer tiste, za katere se je izkazalo, da so ključni za vrednotenje kulturne, družbeno-prostorske in institucionalne (regulativne) dimenzije trajnosti grajenega okolja. Obenem se osredotočamo na tista področja, ki so se izkazala za najbolj problematična z vidika pridobivanja podatkov in njihove integracije v celotni sistem. Pri tem vzdržujemo kontinuiteto zasledovanja pglavitnega cilja, to je, izboljšanje pogojev za podatkovno-podprto odločanje pri ukrepih in intervencijah ob prenovi sosesk.

KLJUČNE BESEDE

integracija podatkov, prostorski podatki, soseska, vrednotenje kakovosti

ABSTRACT

The paper outline and debate the approach, methodologies and nature of the expected results within the ongoing project. The research proposes novel methodologies to support integrating, optimising, and capturing heterogeneous neighbourhood-scale data, with application to decision-making in renewal and sustainability improvements of Slovenian settlements. Following our previous research where relevant sustainability metrics were sought to be integrated into a common sustainability performance index, we continue with the most persistent issues encountered. While the previous research has built on the system-holistic approach, here we progress with the contracted focus to crucial social, cultural, historical, and, ultimately, economic dimensions, which steer the course of neighbourhoods' development. At the same time we dedicate our efforts to the areas that have proven to be the most problematic in terms of data acquisition, its accessibility and integration into common assessment system. In doing so, we maintain the pursuit and continuity

of the main objective, that is, to improve the potentials of the data-supported decision-making in renewal actions and interventions.

KEY-WORDS

data integration, geo-spatial data, neighbourhood, quality assessment

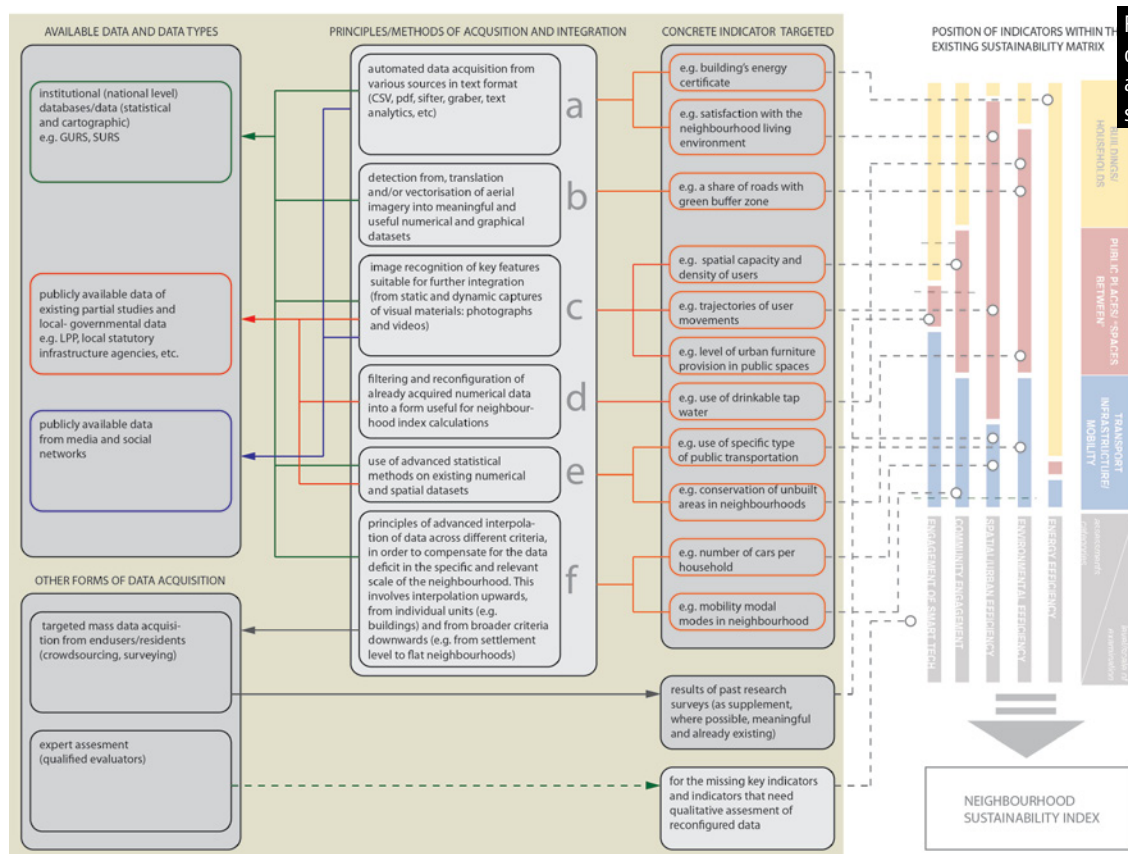


Figure 1: Interconnection of the current research approach with the pre-set sustainability matrix.

1. INTRODUCTION

The research project proposes novel methodologies to support integrating, optimising, and capturing heterogeneous neighbourhood-scale data, with application to decision-making in renewal and sustainability improvements of Slovenian neighbourhoods and settlements. Following our foregoing research where relevant sustainability metrics were sought to be integrated into a common sustainability performance index, we continue with the most persistent issues encountered while continuously pursuing data-supported decision making. At this juncture, we consider the collaboration between urban sciences and computer sciences as essential. In Slovenia particularly, the research that links architectural and urban subjects with advanced computer technologies has been so far rare. Linking is mostly limited to conventional IT support to certain tasks (GIS support, BIM design, 3D visualization, 2D rendering, and similar); however, there is little research that would present a mutual challenge – both in spatial and related sciences and in terms of information technology solutions and methodologies processes (artificial intelligence, machine learning, algorithmic design, etc.).

Therefore, the project progresses and builds on Slovenia's emerging research strength in urban analytics and IT support and makes a contribution towards research and professional infrastructure both for the urban research community, policy makers, and broader planning and design community to develop innovative, evidence-based urban strategies.

2. THE ROLE OF NEIGHBOURHOOD SCALE

With continuing expansion of urbanized areas the basic operating component of strategic planning, research and also assessment has become the scale of the neighbourhood or a local community, providing a manageable and at the same

time diverse unit with the ability to contribute a lion's share to attaining sustainability objectives and the quality living objectives. Existing research (e.g. Hemphill, 2014; Zheng et al., 2017 etc.) already established that the neighbourhood scale, when compared to the city scale on the one hand and to the single-building scale on the other, allows for more integrated actions, achieving sustainability goals directly or indirectly, through related issues.

Research on the relations between neighbourhood organization (form and community) and sustainability targets has therefore increased substantially, linking the broad interest among policymakers, research initiatives, and neighbourhood communities to assure more sustainable and liveable living environments. Analyses on the neighbourhood scale impose a significant influence on the issues such as traffic flows and mobility patterns, waste and water management, green areas management, liveable design of the streetscape and public space, awareness and consumers' behaviour, community engagement, the use of IC technology for mitigating negative environmental impacts, etc. The question of the quality and sustainability optimization of the existing neighbourhoods proved to be relevant particularly in combination with the data-driven decision making and related methodologies that enable benchmarking (Zheng et al., 2017), comparison between neighbourhoods' settings and strategic decisions on priorities in renewal.

3. DIVERSITY OF DATA

The diversity, availability and consistency of data sources for specific relevant domains and within certain spatial scales (district, neighbourhood, public space, street, etc.) are often very inconsistent and fluctuating. On the one hand we are facing an increasing amount of gathered data that reflect each urban system's performance as well as related characteristics and processes. On the other hand we are faced with significant

data scarcity, especially within the small-scale, micro-urban, and fine-grained records, by which we define and track the parameters such as street enclosure or transparency, light pollution, connectivity, human scale, etc. One of the critical remarks made by other authors (Bird, 2015; Lützkendorf & Balouktsi, 2017) is that assessment (monitoring) models do not offer evaluation of less tangible aspects of sustainability & quality, such as the experiential perception of place, users' dynamics and their activities taken in a place, place tidiness, its visibility, the diversity in space or its perceptual identity, etc. These variables are less defined and highly structured and thus difficult to measure; however, they have a significant impact on user experience and one's perception of a quality living environment. The perception of the latter is often largely due to either sustainable/prudent or weak design decisions.

National and municipality-related institutions create and operate on datasets based on specific purposes which are designed for problems at hand; resulting in discrete and incompatible databases, disconnected time series, reciprocally incompatible data queries characterized by diverse data models, and storage structures (Sharifi & Murayama, 2015; Liu et al, 2017). Integration and processing of data queries (for the purpose of sustainability and quality assessments) are currently most often performed in a manual fashion, hence requiring great amounts of time and effort, while also increasing the risk of errors in the aggregation process.

4. METHODOLOGICAL APPROACHES

According to the background described and problems identified, the main objective of the proposed research is to promote new methods that support, extend, and upgrade the current monitoring and assessment protocols and further allow for: more integrated, further automated more modular structures of the data and parameters for assessing neighbourhoods' sustainability and quality rate.

According to our initial estimates, the lack of data interoperability disrupts, slows down and limits the chain of data connections because it requires the engagement of time, manual entries, transcriptions and the engagement of additional resources. The project not only seeks solutions solely in the interoperability and use of accessible, readily available tools for data mitigation, but also in their adaptation for the development of the sustainable index of neighbourhoods.

To bridge the mentioned gap, the following principles and solutions are targeted: automated data acquisition from various sources in text format (CSV, pdf, sifter, text analytics, pdf, EPUB, FB2 etc.); detection from, translation and/or vectorisation of aerial imagery into meaningful and useful numerical and graphical datasets; image recognition of key features suitable for further integration; filtering and reconfiguration of already acquired numerical data into a form useful for neighbourhood index calculations; use of advanced statistical methods on existing numerical and spatial datasets; principles of advanced interpolation of data across different criteria, in order to compensate for the data deficit in the specific and relevant scales, this involves interpolation upwards, from individual units (e.g. buildings) and from broader criteria downwards (e.g. from settlement level to flat neighbourhoods).

Due to the wide scope of the research framework and the accompanying wide range of potentially interesting databases and data types, the work programme was designed as a series of scenario testbeds in (initially) separate theoretical and appli-

ed assemblies. The proposed workflow allows us to study in detail selected data assemblies and actual IT-supported solutions.

The proposed scheme represents the course and focus of the work on the systematic elimination of interference barriers and different types of data, which at the same time lead to the acquisition of the final assessment of the sustainability of each testbed neighbourhood.

5. CONCLUSION

There are two main reasons why we consider targeting the objectives of this research important: (i) to offer urban decision-makers a supporting instrument that can inform and substantiate spatial interventions in the renovation process of different neighbourhoods through a consistent and standardized framework of key indicators/criteria; (ii) to enable spatial users and residents to have a clear insight into the state of the neighbourhood, its sustainability and quality, at the same time encouraging them to increase their commitment to improvements (in various ways: through changing non-sustainable habits, their own monitoring, their own contribution of data, etc.)

We believe that fine-grained urban sensing coupled with well-established remote sensing mechanisms and official data records greatly enhances our potentials in terms of increased geographical resolution of captured data, denser timescale, and finer eloquence. Consequently, the envisioned methods cope with the most critical issues in this domain and make it easier and more cost effective to identify segments of high and low sustainability performances, and thus, guide urban diagnostics, responsive policies as well as prioritize smart investments. Prudent reuse of the existing data besides is strongly in line with the current tendencies and EU policies towards rationalization in new data captursings.

References

- Bird, K. (2015). *Neighbourhood Sustainability Assessment: Connecting Impact with Policy Intent*. Burnaby: Simon Fraser University.
- Liu, L., Silva, E. A., Wu, C., & Wang, H. (2017). A machine learning-based method for the large-scale evaluation of the qualities of the urban environment. *Computers, Environment and Urban Systems*, 65, 113-125.
- Hemphill, L., Berry, J., & McGreal, S. (2014). An indicator-based approach to measuring sustainable urban regeneration performance: part 1, conceptual foundations and methodological framework. *Urban studies*, 41(4), 725-755.
- Sharifi, A., Murayama, A. (2015). Viability of using global standards for neighbourhood sustainability assessment: Insights from a comparative case study. *J Environ Plan Manage*, 58, 1-23.
- Statistični urad Republike Slovenije (SURS). Klasifikacije, vprašalniki in metode. <https://www.stat.si/StatWeb/Methods/ClassificationsQuestionnairesMethods> (19. 6. 2019).
- Zheng, H. W., Shen, G. Q., Song, Y., Sun, B., & Hong, J. (2017). Neighborhood sustainability in urban renewal: An assessment framework. *Environment and Planning B: Urban Analytics and City Science*, 44(5), 903-924.

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