# RESEARCH ON ENGINEERING AND MANAGEMENT OF SUSTAINABLE URBAN DEVELOPMENT PROJECTS

**PhD THESIS – ABSTRACT**

**for obtaining the scientific degree of PhD at**

**Politehnica University of Timişoara**
**in the PhD field of Engineering and Management**

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**June 2025**

## 1. Summary of the PhD Thesis

In 2015, the United Nations Agenda included for the first time the goal for sustainable urban development (SUD) "to make cities and human settlements inclusive, safe, resilient, and sustainable" [1]. Meeting the basic needs of the growing urban population remains one of the major challenges of our time, as cities are critical locations for numerous complex issues related to sustainability, development, and urban planning. Increasingly, these are conceptualized less as problems and more as sources for sustainable urban development. Urban areas are incubators of innovation, capable of supporting densities that ensure efficient provision of services, energy, and land use [2], through smart planning of green space revitalization, implementation of environmentally friendly technologies, recycling, and ensuring smart urban mobility in areas of significant community interest.

The PhD thesis titled "Research on Engineering and Management of Sustainable Urban Development Projects" addresses the priorities of sustainable urban development (SUD) from the perspective of project management at the level of local public authorities/organizations and the integration of all aspects of SUD related to a portfolio of projects evaluated according to SR ISO 37120:2020, so that a balance between economic growth, social well-being, and rational use of natural resources is maintained [3].

Significant societal changes -such as the application of environmental strategies and fundamental policies for sustainable development [4], [5], the impact of the pandemic context, social and economic instability, demographics, advances in artificial intelligence - are reshaping how sustainable urban development (SUD) projects are applied within society and organizations. The challenge of SUD projects is to transform societal components into systemic elements adapted toward a green transition, capable of ensuring a high standard of living for an indefinite period, regardless of cultural forms, scientific and technological limitations, social dimensions, initiative flexibility, educational levels, information flow (form, size, and complexity), paradigm shaping, decision maturity, and narrative perspectives. Overall, an SUD project is a transitional interface between a currently unsustainable society—focused on irrational resource consumption—and a sustainable society that uses, regenerates, and assigns functions to these resources within multiple operational processes.

These aspects, which create a favorable research context, are driven by a general concern for the sustainable urban development (SUD) of the smart city, from the perspectives of mobility, innovation, and adaptation to environmental changes centered on community needs [6]; the rehabilitation of urban zones/divisions/subdivisions through investments in public spaces and green areas, fully aligned with the SR ISO 37120:2020 standard to enable more efficient and systematic evaluation of the impact of projects in the field of SUD; the integration of urban form, social parameters, and other elements of the urban fabric in terms of heritage and urban regeneration by identifying and implementing sustainable urban development measures.

Projects for the sustainable development of urban areas incorporate the concept of sustainability to ensure a durable way of life for future generations. Accordingly, urban development projects must expand their vision regarding associated environmental impacts and results concerning the integration and influence of sustainability [7].

Integrating the sustainability concept into project management processes involves incorporating sustainability principles into the knowledge areas of project management (Appendix 2) to enable close identification according to the Project Management Institute (PMI) 2014. Implementing sustainable project management (PM) indicators during management processes automatically generates a positive impact on local communities [8].

Project management indicators monitor how an infrastructure project can be managed in accordance with the triple bottom line of sustainability (TBL), using suitable project control mechanisms, especially during planning and execution phases [9]. Thus, the research subject of this PhD research is at the mesoeconomic level, where stakeholders involved in the built environment industry interact among themselves and with the communities they serve, including through intersectoral networks operating at various levels of interest.

The identification and systematization of needs underlying the objectives of sustainable urban development derive from: defining the process of urbanization, highlighting related improved concepts, identifying transversal problems related to urbanism, urbanization, and cities, necessary allocations to study the complexity of urban systems, integrated planning, development of evidence-based public policies, and monitoring by effective governance.

This research aims to explore the development of sustainable urban areas and the management of investment projects at the organization/local public administration (UAT) level through a critical-analytical approach to political, economic, and social contexts influencing decision-makers. The main research areas pursued - though not limited to - are sustainable, smart, and resilient urban mobility; Smart City initiatives and civic engagement; urban regeneration of cultural heritage.

Considering the current reality and the consequences of resource depletion, issues related to SUD have become important topics addressed in academic, socio-cultural forums, national and international bodies, and organizational action. “A sustainable society is one that shapes its economic and social systems so that natural resources and life support systems are maintained for as long as possible” [10].

**The main objective of this research is to establish a model/process for prioritizing and integrating all aspects of SUD related to a project portfolio, ensuring an optimal impact (measured according to SR ISO 37120:2020).** The PhD research theme titled “Research on Engineering and Management of Sustainable Urban Development Projects” is conducted within the methodological framework provided by project management, with the goal of advancing

sustainable urban development (see Fig. 0.1).

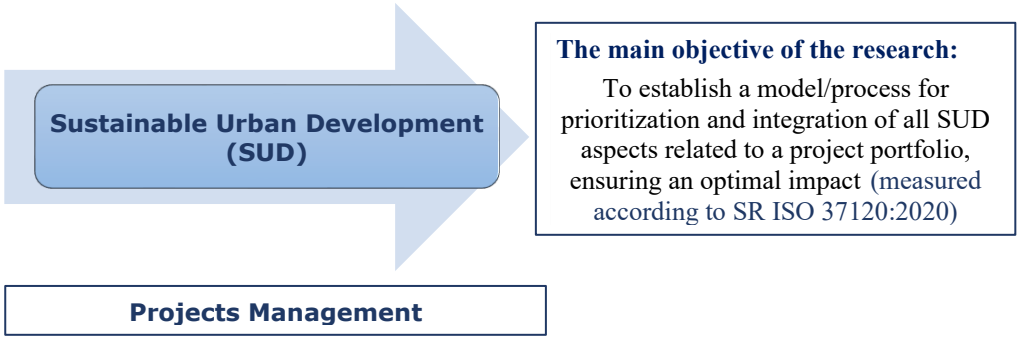


*Fig. 1 The context and objective of the PhD research*

According to processed global statistical data [11], 70% of the world's GDP is generated by economic activities located in urban areas, and 53% of the total world population lives in urban environments. Moreover, it is estimated that by the year 2050, approximately 70% of the global population will reside in cities. Thus, it has been recognized that a process of structural transformation of urban areas is occurring worldwide, driven by the emergence and expansion of metropolitan zones (increased urbanization with the rise of emerging megapolitan regions), and the United Nations estimates that 230 billion square meters of new constructions will be added to the built environment over the next 40 years—that's equivalent to adding another Paris to the planet every week [12]. All these developments necessitate transformative and innovative changes in the field of built environment planning and an integrated approach by Sustainable Urban Development (SUD) initiatives. Recent research has shown that at the current rate of urban expansion, global temperatures could rise by another 1–2°C [12]. This significantly worsens risks associated with climate change, such as droughts, floods, extreme temperatures, species extinction, and poverty affecting hundreds of millions of people. In addition to climate change, Europe faces the challenge of an aging population, which poses further difficulties for new sustainable urban development solutions [13].

Assessing solutions and quantifying their impact for SUD projects are crucial, both for initiators and final beneficiaries, as well as for managers of affected urban areas or administrative units. The introduction of the SR ISO 37120 standard allows measurement of the impact of SUD projects, establishing a more effective framework for evaluation, diagnosis, monitoring, and control related to urban spaces, and expands the use of quantitative methods typically employed in urban audits.

The research questions addressed are:

1. Which are the most effective decision-related approaches in planning activities throughout a project cycle (funded by structural funds and others) to ensure its efficient implementation (including risk management, resource optimization, and time management)?

2. How should the aspects of SUD (green and inclusive mobility, implementation of convergent solutions for defining smart cities/towns, valorization of urban heritage, urban regeneration, etc.) be prioritized and integrated to achieve a real impact in improving living standards in our cities?

Consequently, the research aims to assist responsible stakeholders and decision-makers involved in SUD, who face new challenges such as an increasingly large and aging population, growing pressure on natural resources, and global warming. These challenges will have long-term effects and must be integrated into an innovative approach to define a new framework for action in the field of SUD. The findings will have profound implications for the planning and implementation of SUD projects, as well as on residents' quality of life, citizens' well-being, and the business environment in the region. The adopted approach is bottom-up, starting from the micro-level toward the mesoeconomic level in the field of sustainable development project management, with a focus on processual investigation of how to achieve community-specific indicators for green communities, along with managerial decision-making related to the prioritization and selection of suitable SUD projects within a portfolio.

Methodologically, theoretically, and scientifically, the support for achieving the overall objective of the PhD thesis relies on utilizing convergent public data to establish a prioritization and integration model/demonstration that measures all aspects according to SR ISO 37120:2020.

Bibliographic, theoretical, and applied research in SUD offers convergent solutions for defining priorities at the city/town level, leveraging urban heritage, ensuring sustainable mobility and urban regeneration under the umbrella of project management and smart city elements. These priorities are approached from a methodological perspective provided by project management practices. This combination offers the opportunity to develop a model for project prioritization in urban development at the organizational level, establishing a clear framework for monitoring and controlling urban investments—optimizing risk, time, and resource management—fully aligned with the assessment requirements of SR ISO 37120:2020. This prioritization and integration model of SUD aspects is a valuable tool for setting priorities within the framework of Integrated Urban Development Strategies (IUDS), linked to organizational or territorial project portfolios responsible for developing sustainable communities. The "Urban Objective" (UN 2016) emphasizes making cities and human settlements inclusive, safe, resilient, and sustainable, addressing factors that heavily influence urban quality of life—such as public transport, urban space planning and revitalization, and innovation. It provides a vision for SUD in tackling global challenges [14].

Both the European and local levels prioritize this objective, as evidenced by at least 50% of allocations from the European Regional Development Fund (ERDF) dedicated to urban strategies for regulating SUD documents [15], improving urban environments, promoting urban regeneration, and supporting innovative actions [16], as outlined in the Toledo Declaration. This declaration states that integrated urban development must "transcend borders and traditional approaches to address the city as a fully functional entity and its components as a unified urban organism, with the aim of developing and balancing the complexity and diversity of social, economic, and urban structures, while simultaneously fostering greater eco-efficiency of the surrounding environment" [17].

The structural content of the PhD thesis, along with the logical approach to research themes, is presented in Fig. 0.2.

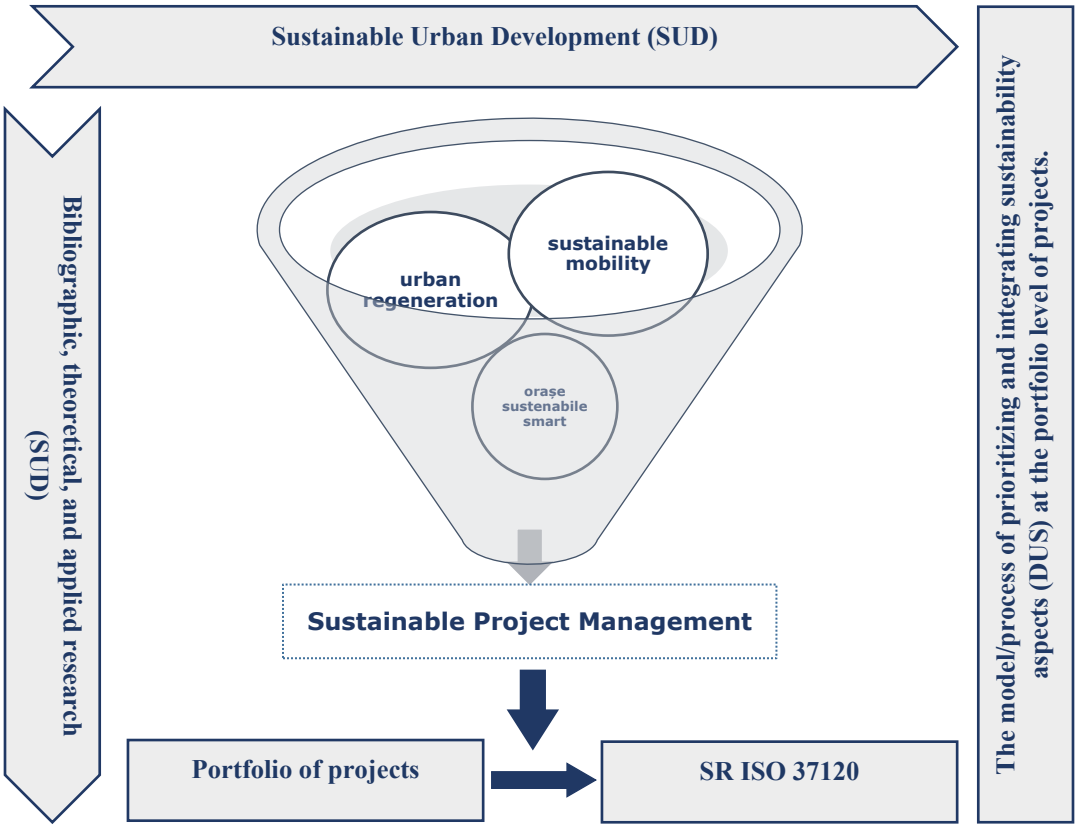


*Fig. 2. Logical schema of the PhD thesis*

Regarding the operational objectives of the research, these are pursued through the investigations described in each chapter of the thesis, as follows:

**Objective 1 – O1. Bibliographic analysis and synthesis regarding the current state of knowledge in the field of Sustainable Urban Development (SUD):**

- (A.1.1) Identification and systematization of the main theoretical-methodological approaches for defining the concept of SUD based on the investigation of existing works in both national and international specialized literature;
- (A.1.2) Definition of the conceptual framework of the research (terminology);
- (A.1.3) Development of a taxonomy of the SUD field (aspects that should constitute research variables);
- (A.1.4) Definition of the procedural framework of the research (creating an inventory of models of sustainable urban development, examples of good practices identified in the "grey literature").

**Objective 2 – O2. Secondary data analysis regarding trends of indicators characterizing sustainable urban development at European and national levels (process and impact indicators):**

- (A.2.1) Identification of relevant specialized reports on the SUD field – at both European and national levels – synthesis of grey literature;

- (A.2.2) Identification of relevant databases and indicators characterizing SUD;
- (A.2.3) Synthesis of statistical indicators.

**Objective 3 – O3. Research on stakeholder satisfaction levels involved in sustainable urban development projects (marketing research with developers, implementers, and beneficiaries of projects in the Western Region and Caransebeș Municipality, correlated with the provisions/domains evaluated by SR ISO 37120:2020):**

- (A.3.1) Conceptual model of integrated urban development;
- (A.3.2) Design of the research scenario and methods for data collection and processing;
- (A.3.3) Data processing and interpretation.

**Objective 4 – O4. Theoretical research on developing a model/approach for prioritization and integration of all aspects of SUD related to a portfolio of projects to ensure optimal impact (measured according to SR ISO 37120:2020):**

- (A.4.1) SUD dimension at the level of the Western Development Region;
- (A.4.2) Market research on SUD in the Western Development Region;
- (A.4.3) Analysis and research results regarding SUD;
- (A.4.4) Presentation of research priorities for SUD: sustainable urban mobility, smart city, urban regeneration.

**Objective 5 – O5. Applied research to test and validate the proposed model/approach:**

- (A.5.1) Development of the theoretical model/approach for prioritization and integration of all SUD aspects within a project portfolio;
- (A.5.2) Adaptation of this model in the case of Caransebeș Municipality;
- (A.5.3) SWOT diagnostic analysis at the project portfolio level of Caransebeș Municipality;
- (A.5.4) Establishment of the working methodology and the design of the SUD Project Management Plan for a project portfolio at the community level, according to SR ISO 37120:2020.

**Objective 6 – O6. Dissemination of results:**

- (A.6.1) Publication of at least 2 articles in ISI-indexed journals / ISI Proceedings;
- (A.6.2) Publication of at least 3 articles indexed in BDI;
- (A.6.3) Participation in 3 international conferences.

**Objective 7 – O7. Drafting the PhD thesis;**

**Objective 8 – O8. Defense of the PhD thesis.**

The scientific research related to the PhD program is presented in 6 chapters and 34 subchapters. Chapter 1 aims to systematize knowledge at the SUD level, as a continuous process of understanding the city as a functioning whole. This is achieved by identifying the theoretical-methodological approaches for defining SUD, namely the conceptual framework, procedural aspects, relevant data sources, and specialized reports on the investigated field.

Chapter 2 – "Sustainable Urban Development – Analysis of the Normative and Legislative Framework" is dedicated to research for defining the legislative normative framework related to SUD, analysis of relevant specialized reports at the European and international levels, and

characterization of SUD from the perspective of compliance with ISO 37120 standards.

In Chapter 3 of the PhD thesis, preliminary theoretical research is presented, describing the research methodology. The content of this chapter is the result (a synthesis for planning purposes) of the investigations described in Chapters 1 and 2.

The applied research presented in Chapter 4 emphasizes the need to strengthen awareness and action in the field of urban green infrastructure, highlighting the importance of updating policies and collaboration among various sectors to implement sustainability standards. To promote sustainable development, active civil society involvement, diversification of funding sources, and professional training are recommended. Communities in the Western Region can accelerate the transition to sustainable cities through concrete actions and strategic planning.

Chapter 5 promotes a model of sustainable urbanism focused on health, social equality, community involvement, and preservation of green spaces, supported by strategic SUD projects aimed at economic, social, and environmental value. The implementation of these projects is carried out through integrated, sequential, and adaptable management, utilizing digital tools and modern methodologies for monitoring, evaluation, and coordination, with an emphasis on sustainability and active community involvement. Through a holistic and iterative approach, project management ensures alignment with the local vision, promoting efficient, inclusive, and sustainable urban development with benefits for the entire community.

Chapter 6 – "Conclusions, Original Contributions, and Future Research Directions" summarizes the findings of the conducted research. Section 6.1 provides general conclusions, emphasizing the impact of economic, social, and environmental dimensions on sustainable urban development. This is followed by Section 6.2, which presents the categories of original contributions brought to the field studied, and Section 6.3, which proposes directions for future research expansion.

## 2. Original Research Contributions

The PhD thesis, developed between 2021 and 2025, makes significant contributions to the field of sustainable urban development (SUD), addressing both theoretical, methodological, and practical aspects. Through extensive and innovative research, progress has been made in understanding the concept of SUD, contributing to its definition and systematization, as well as identifying relevant models and indicators for evaluating and promoting sustainable urban development.

Firstly, the research conducted an extensive bibliographic synthesis on the concepts of sustainable urban development at both national and international levels. The theoretical and methodological framework was identified and systematized, including the definition of a terminological framework and a specific taxonomy for the SUD field. Inventories of sustainable urban development models were created, and trends in process and impact indicators were analyzed to better understand the evolution and dynamics of this domain.

A proprietary definition of SUD was proposed: a set of tools and intelligent technologies used by local communities to limit and regenerate resource consumption, aiming to create a bridge of innovation and to maintain resilience across generations. This definition emphasizes technology, innovation, and intergenerational responsibility, grounded in literature analysis and European and

national trends.

A graphic element (logogram) was created for the visual identification of the concept, and relevant reports and databases, as well as specific indicators for characterizing SUD, covering multiple dimensions: administrative, spatial, economic, heritage, social cohesion, culture, and Smart City, were identified. Thus, the research highlights the complexity and interdisciplinarity of the field.

From a theoretical perspective, research objectives and the approaches to achieving them were defined, including an analysis of organizational compliance with ISO 37120:2020 standards and the integration of urban indicators into strategic documents. Opportunities for funding and the involvement of local actors in project implementation were explored, along with the development of a conceptual model for experimental research aimed at validating the relationships between engineering and project management in SUD.

Regionally, the research focused on the Western region, addressing priorities such as sustainable urban mobility, smart city initiatives, and urban regeneration. A data collection model based on five dimensions was operationalized to evaluate environmental impacts and organizational effects, as well as to underpin investment decisions in SUD projects.

Applied research targeted the Municipality of Caransebeș, conducting a market analysis of SUD, including a SWOT diagnosis of the project portfolio and modeling of management plans according to ISO standards. The study also analyzed green communities and perceptions related to sustainability, integrating international experiences and best practices in project management to prioritize and implement concrete projects.

In the didactic realm, the research results were integrated into master's programs at the Faculty of Production and Transport Management (UPT), contributing to the expansion of both theoretical and practical knowledge in the field. Additionally, a significant publication activity was developed, with 14 scientific works published in international journals and volumes, eight of which are indexed in Thomson Reuters databases (ISI Web of Science).

In conclusion, this thesis represents an original and valuable contribution to understanding and promoting sustainable urban development, providing conceptual frameworks, methodological tools, and practical solutions for implementing SUD projects at both national and regional levels, and supporting educational and managerial development in the field.

## 3. Future Research Directions

Future research directions in the field of project portfolio management and sustainable urban development highlight multiple avenues for advancement. Firstly, expanding studies into sustainable project management at the portfolio level becomes essential to address global challenges related to environment, society, and economy. It is proposed to integrate sustainability criteria into project selection, alongside innovation and advanced technologies, to transform how organizations plan and implement initiatives. In the urban planning domain, research on the use of artificial intelligence (AI) in urban planning represents a promising area, given the gap between theory and practice. AI can support the development of smart cities by optimizing public transportation, traffic management, increasing safety, and reducing environmental impact, automating processes and facilitating strategic decisions. Additionally, AI contributes to urban

planning based on the analysis of demographic and economic data, promoting sustainable and efficient urban infrastructure development.

Another important direction involves the relationship between technology and social media platforms (LinkedIn, WhatsApp, Twitter, Facebook), which can support sustainable urban development by promoting communication, collaboration, and civic participation. These platforms facilitate citizen involvement, mobilize communities, and can become virtual spaces for experience exchange and innovation in urban planning.

At the same time, research must address ethical aspects such as misinformation, discrimination, data privacy, and transparency in decision-making processes to ensure equitable and responsible development. In conclusion, these research directions aim to strengthen sustainable management and the use of advanced technologies to create smarter, more inclusive, and sustainable cities.

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