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Planning Proximity: A Critical Perspective on Measuring the 15-Minute City

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Abstract

Although the 15-minute city has become a prominent paradigm in contemporary urban planning, the conditions under which urban proximity can be meaningfully measured and operationalized remain insufficiently defined. While it has gained widespread recognition through its strong political and scientific appeal, it remains characterized by methodological and operational ambiguities, reflecting a persistent gap between its rhetorical appeal and its practical implementation in urban planning. Despite the growing number of proximity assessment approaches, no shared conceptual framework currently exists to organize the diversity of existing methodologies. Existing assessment approaches—predominantly grounded in GIS-based and quantitative methods—struggle to capture the multidimensional nature of urban proximity.

This article presents a critical comparative review of 47 proximity assessment methodologies covering the period 2016–2025. Rather than conducting a systematic review, the study adopts a critical analytical approach to examine how urban proximity has been conceptualized, measured, and operationalized across different disciplinary traditions and urban contexts. Three principal findings emerge from the comparative analysis: the disciplinary compartmentalization of proximity assessment, largely dominated by engineering and GIS-based approaches; the absence of a shared conceptual framework despite the plurality of "X-minute city" models and assessment methodologies; and the underrepresentation of polycentric medium-sized cities, despite their strategic role within the European urban system. Building upon these findings, the article proposes the Integrated Proximity Matrix as a conceptual synthesis rather than as a new measurement indicator. The matrix integrates the complementary methodological dimensions identified across the reviewed literature into a coherent conceptual architecture intended to support the future development of context-sensitive proximity assessment methodologies. Developed within the broader context of an ongoing doctoral research project conducted in Prato (Italy), this framework constitutes the conceptual bridge between the comparative findings presented here and their future empirical implementation and validation in urban planning practice.

Keywords

Proximity-based approach; X-minute city; Planning indicators; Urban sustainability; Spatial diagnostic

1. Introduction

In the aftermath of the global COVID-19 crisis, the concept of the "15-minute city" has emerged as a central paradigm in urban planning, promoting proximity, quality of life, and territorial resilience (Moreno et al., 2021). Politically and in the media, it is presented as a widely accepted model, aligned with global sustainability agendas such as the C40

Green New Deal, aiming to reconnect residents with their neighborhoods and to decentralize urban life (Pozoukidou & Chatziyiannaki, 2021). Beyond its environmental ambitions, the scientific literature has also highlighted its positive effects on local quality of life and urban equity (Logan et al., 2022; Allam et al., 2022a).

However, behind this attractive slogan lies a more complex reality: the challenge of its operational translation. The adaptability of the concept—whether framed as a 10-, 15-, 20-, or 45-minute city—reflects both its mobilizing power and its methodological fragility. Questions remain regarding which thresholds to adopt, the units of measurement, the points of departure, or the categories of services, revealing a persistent ambiguity around the very criteria of proximity (Megahed et al., 2024).

This article addresses these ambiguities by examining how urban proximity can be measured, qualified, and potentially integrated into planning strategies. The reflection developed here is informed by ongoing fieldwork conducted in Prato, which serves as an illustrative context for discussing future operational applications rather than as an empirical case study. The scientific challenge is to recontextualize the concept of proximity and to consider its operationalization to move beyond its perception as a mere utopia.

2. Problem statement and study aim

Although widely discussed in recent literature, the concept of proximity-based planning still needs a clearer definition and a more precise positioning. Considering the abundance of research, it appears necessary to situate existing approaches and critically examine their underlying assumptions. Proximity urbanism is inherently complex: it draws upon multiple disciplinary fields—ranging from urban planning to mobility engineering and including urban sociology—and requires a gradual implementation structured in several stages, as illustrated by the diversity of approaches surrounding the 15-Minute City.

While the concept of the 15-minute city has reintroduced the notion of proximity into debates on sustainable urbanism, its translation into concrete planning tools remains problematic. This difficulty is reflected in the proliferation of operational initiatives developed by planning authorities, research teams and geovisualization platforms. Although these initiatives have considerably advanced the practical implementation of proximity-based planning, they rely on heterogeneous indicators, datasets and analytical logics, making comparisons between approaches difficult and limiting their transferability across urban contexts. A persistent tension exists between the mobilizing force of the concept within political and scientific discourse and its limited applicability in planning practices (Pozoukidou & Chatziyiannaki, 2021). Existing methodologies for measuring proximity struggle to simultaneously meet the demands of quantitative rigor, political and social stakes, and the specificities of local contexts (Megahed et al., 2024). What could be measured and mapped in Toulouse—as demonstrated by the applied study of the Chaire ETI (Master SIGAT & Chaire ETI, 2021)—may not be directly transposed as a model to other urban realities. This article therefore seeks to critically position itself within the expanding scientific debate surrounding the 15-minute city by examining the conditions under which proximity can become operational in planning practice. This analysis is anchored in the broader framework of an ongoing doctoral research conducted in Prato (Italy). In this article, the objective is not to develop or validate an operational methodology, but rather to establish the conceptual foundations required for its future implementation.

This methodological diversity reflects a deeper conceptual ambiguity regarding what urban proximity means. This ambiguity is evident both from the perspective of conceptual models—through the coexistence of temporal variants such as Portland's 20-minute neighborhood, Melbourne's 20-minute neighborhood (10-minute walk to the destination and 10 minutes back home), or Singapore's 45-minute city—and from the perspective of calculation methods employed in spatial models, referred to here as proximity measurement indicators. Which thresholds should be adopted? Which units of measurement—metric or temporal isochrones? From which points of departure, along which road networks, and for which types of services?

More specifically, this article makes three contributions to the current debate on proximity-based urbanism. First, it critically examines how urban proximity has been conceptualized and operationalized through existing proximity assessment approaches. Second, it highlights the underrepresentation of European medium-sized polycentric cities in the literature and questions the transferability of indicators developed primarily for metropolitan contexts. Third, it

proposes an Integrated Proximity Matrix as an exploratory planning framework intended to bridge the gap between spatial diagnostics and planning implementation. Proximity cannot remain an empty signifier: it must become an operationalizable, contextualized, and measurable category of public action. **Figure 1** summarizes the research framework guiding the study and illustrates how the critical analysis of existing proximity assessment approaches leads to the development of the Integrated Proximity Matrix, conceived as a conceptual framework for subsequent empirical implementation.

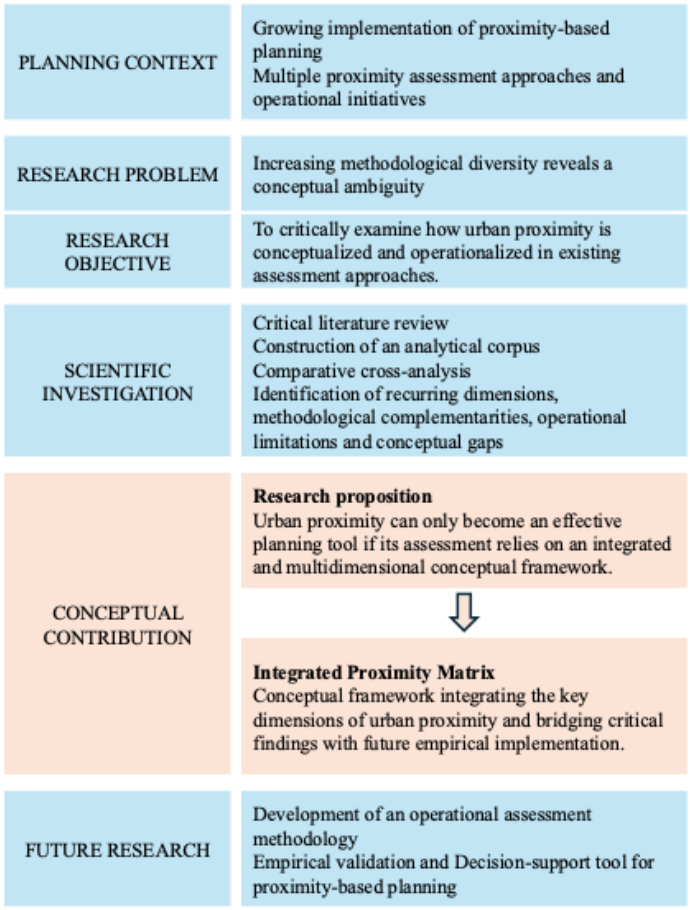

Figure 1. Research framework of the study.

3. Literature Review

The objective of this review is to provide a scientific overview of debates surrounding the concept of the "15-minute city," integrating both theoretical approaches and practical considerations. Particular attention is paid to the indicators used to assess the measurability of this urban model, which constitute the methodological foundation of this study.

The 15-minute city has been frequently studied in recent literature as a response to contemporary challenges of urban sustainability, proximity planning, and spatial justice (Allam et al., 2022b; Silva et al., 2023). Several works trace its intellectual genealogy, linking it to earlier neighborhood planning theories (Sharifi, 2016) and broader territorial approaches emphasizing human-scale urbanism (Khavarian-Garmsir et al., 2023). In this sense, the model can be seen as part of a long-standing tradition of proximity-based planning.

The translation of the concept into planning practice has generated diverse interpretations and objectives. Studies analyze how the 15-minute city is framed in policy documents (Gower & Grodach, 2022) and assess its adaptability and effectiveness (Lu & Diab, 2023). Comparative research identifies a wide variety of terminologies and planning strategies (Allam et al., 2024), while global surveys have catalogued hundreds of initiatives across cities worldwide, illustrating the heterogeneity of approaches (Büttner et al., 2024a; Teixeira et al., 2024). Such diversity reflects both the flexibility of the model and the challenge of defining a unified framework.

Scholars also highlight risks associated with decontextualized applications, including gentrification and social exclusion (Mouratidis, 2024; Elldér, 2024). A further controversy concerns the politicization of the concept. Caprotti

(2024) notes how conspiracy theories have reframed the 15-minute city as a tool of social control, while Marquet et al. (2025) and Glover (2025) trace how these narratives spread after the pandemic, shaping public perceptions and local community reactions. These critiques underline the importance of clarifying and communicating the concept to avoid misunderstandings.

A central strand of research addresses the measurability of proximity. Several indicators have been proposed, including composite indices such as the CSx (Knap et al., 2023) and comparative approaches that account for density and service distribution (Gaglione et al., 2024). Other studies emphasize inequalities in accessibility by integrating socio-demographic data (Caselli et al., 2022). Büttner et al. (2024b) stress the importance of GIS-based tools to map underserved areas and guide planning, while Olivari et al. (2023) present interactive tools like NEXI, which evaluate service proximity based on 15-minute city principles.

Despite this methodological diversity, one common recommendation emerges: indicators must be adapted to local contexts, reflecting social realities, mobility structure, and territorial patchworks. The systematic review by Megahed et al. (2024) highlights that most metrics rely on physical measures (walking time, distance, network analysis) while neglecting behavioral and social dimensions. This gap underscores the need for more holistic approaches.

The 15-minute city also reopens debate on what proximity really means. As Boschma (2005) argues, proximity is multidimensional—geographical, social, cognitive, organizational, and institutional—and cannot be reduced to distance alone. Solely physical measures risk overlooking community dynamics, symbolic attachments, and political relationships that shape lived space (D'Onofrio & Trusiani, 2022). This relational perspective echoes Lefebvre's (2009) "right to the city" and Morin's (1992) "right to existence," highlighting how urban form can support symbolic and material redistribution. Recent studies (Allam et al., 2024; Khavarian-Garmsir et al., 2023) similarly stress that planning based only on physical interventions is insufficient to drive sustainable urban transitions, especially in contexts marked by systemic crises.

Overall, the literature reveals both the richness and ambiguity of the 15-minute city concept. It is simultaneously a theoretical model, a flexible planning framework, and a contested political idea. Empirical studies underscore the need for context-sensitive measurement tools, while critical perspectives call for attention to social justice and the relational dimension of proximity. Rather than applying a standardized model, the challenge lies in tailoring the 15-minute city to diverse urban realities, balancing spatial, social, and symbolic dimensions.

The literature review reveals two complementary forms of diversity. First, the 15-minute city has developed into a broad scientific field encompassing conceptual debates, planning strategies, political interpretations, and operational applications. Within this expanding body of research, proximity assessment emerges as a distinct methodological field whose approaches differ considerably in terms of indicators, datasets, analytical tools, and spatial scales. This diversity raises a fundamental question: rather than identifying a single optimal indicator, how can these complementary approaches be understood and organized within a coherent conceptual framework? Addressing this question requires moving beyond the general literature on the 15-minute city toward a focused comparative analysis of proximity assessment approaches.

4. Methodology

This article should be understood as a conceptual and methodological contribution supported by a critical literature review rather than as an empirical validation study. The Integrated Proximity Matrix proposed in the Results section is intended as an exploratory diagnostic framework. Its operational testing constitutes the next stage of the ongoing doctoral research conducted in Prato.

The present study adopts a critical literature review rather than a systematic review. This methodological choice reflects the objective of understanding how urban proximity has been conceptualized and operationalized across existing assessment approaches, rather than exhaustively reviewing all publications related to the 15-minute city. As highlighted in the literature review, the 15-minute city has evolved into an inherently polymorphic scientific field, encompassing conceptual debates, planning strategies, governance issues, political controversies, and methodological developments. This diversity required a clear research positioning within a broad and heterogeneous body of literature

before focusing specifically on the operationalization and assessment of urban proximity. **Figures 2** and **3** summarize these two complementary stages of the research design.

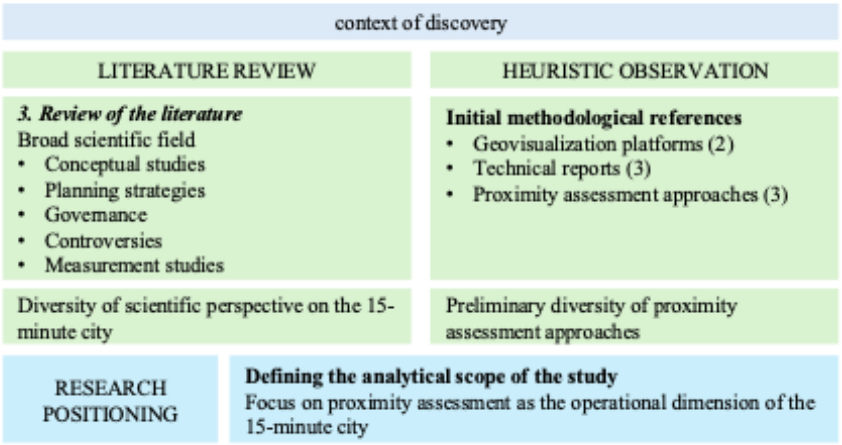

Figure 2. Research positioning of the research object.

The research positioning adopted in this study emerged from two complementary observations. On the one hand, the literature review highlighted the diversity of scientific perspectives surrounding the 15-minute city, making it necessary to delimit the scope of the research within this expanding field. On the other hand, an exploratory examination conducted during the early stages of the doctoral research identified several pioneering methodological references—including geovisualization platforms (Master SIGAT, & Chaire ETI. (n.d.).; Sony Computer Science, n.d.), technical planning reports (Mott MacDonald, & Leeds City Council, 2022; City of Portland Bureau of Planning and Sustainability2012), and operational studies (Ferrer-Ortiz, M. et al., 2022; Lanza et al., 2023; Olivari et al., 2023) —that revealed the diversity of existing approaches used to assess urban proximity. Together, these two complementary observations motivated the decision to focus specifically on the operationalization and assessment of urban proximity as a distinct analytical field within the broader literature on the 15-minute city. Once this research positioning had been established, the analytical corpus was progressively constructed through a structured search conducted in the Scopus database, selected for its broad multidisciplinary coverage of urban studies and planning research. **Figure 2** summarizes this methodological workflow, distinguishing the heuristic process through which the research object was progressively defined from the analytical process used to construct, select, and critically examine the corpus supporting the conceptual framework developed in this study.

Publications were retained when they explicitly proposed, applied, compared, or critically discussed methodologies for measuring urban proximity or operationalizing proximity-based planning. Priority was given to studies offering methodological contributions, diversity in disciplinary perspectives, and variation in urban contexts rather than exhaustiveness. Conversely, publications addressing the 15-minute city solely from a conceptual or political perspective, without discussing measurement approaches or operational methodologies, were not retained. Because several influential methodological innovations initially emerged through planning practice rather than peer-reviewed publications, the corpus also includes a limited number of technical reports and geovisualization platforms whose methodological relevance and influence on operational planning justified their inclusion. The final corpus comprises 47 scientific and technical contributions (Appendix A).

The corpus was subsequently subjected to a transversal critical analysis designed not only to catalogue existing methodologies but also to understand the underlying assumptions guiding proximity measurement. More specifically, the cross-sectional analysis of the 47 contributions focused on comparing the sizes of the cities studied, the urban functions considered, the calculation methods, the data sources, and the dominant disciplinary perspectives underpinning the research (Appendix B). This analysis highlighted recurring methodological dimensions but also revealed important conceptual and operational gaps across the literature. Rather than proposing a new proximity indicator, the objective of this study is to demonstrate that existing assessment approaches capture complementary dimensions of an inherently multidimensional concept. The Integrated Proximity Matrix therefore constitutes the conceptual synthesis emerging from this comparative analysis, integrating these complementary dimensions into a

coherent framework intended to support the subsequent development and empirical validation of an operational methodology for proximity-based planning.

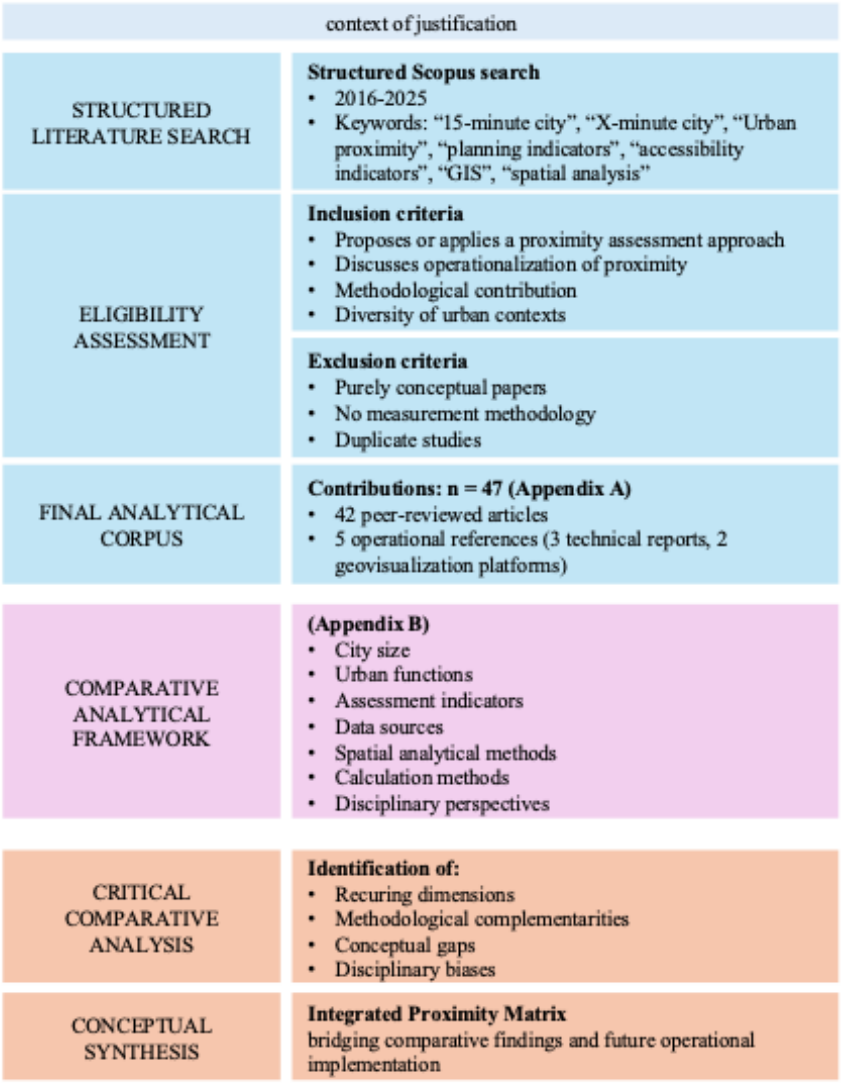

Figure 3. Methodological workflow for corpus construction and comparative research design.

4.1. Initial matrix: geographical contexts, urban functions, and disciplinary fields

4.1.1. Urban contexts under study

The typology of cities into small (50,000–250,000 inhabitants), medium (250,000–500,000 inhabitants), and metropolitan (>500,000 inhabitants) provides a coherent analytical framework for the study of urban systems, both at the European scale and in a broader comparative global context. Indeed, it allows for the consideration of the diversity of urban structures observed across different geographic contexts while offering a projection adapted to the demographic and functional realities of European cities. This classification relies on standards recognized in the European debates on city sizing (European Commission, Eurostat, 2016; OECD, 2018; Del Fiore & Servillo, 2023), which highlight the central role of population size and urban functions in distinguishing intermediate from metropolitan cities. It thus reflects the urban hierarchy by linking demographic size with functional role: small cities primarily perform local functions, medium-sized cities play a regional role, while metropolitan cities exert economic, cultural, and administrative influence at the national and even international level.

The reviewed studies are mainly focused on large metropolitan areas (Barcelona, Shanghai, Bogotá, Rome, Hong Kong…). Of the 47 studies in the corpus, 35 concern cities with more than 500,000 inhabitants. This bias raises questions about the transferability of these methods to medium-sized cities, which nonetheless play a central role in European urban dynamics. These "medium-sized cities" (200,000 to 500,000 inhabitants according to the OECD

(2018)) are often characterized by a polycentric organization, inherited from historically autonomous centralities that have since been integrated into a wider metropolitan dynamic. Such configurations generate tensions between secondary centers and the main city, complicating the implementation of proximity-based urbanism. The diversity of centralities calls for a fine-tuned adaptation of indicators and challenges linear models of accessibility.

4.1.2. Urban Functions Measured

It appears pertinent to examine the functions examined in these articles, as they encompass the full range of services that form the core of the proximity approach. Particular attention will be given later in this article to the study of services, notably regarding the importance of their positioning within an amenities' matrix. The functions examined correspond to the six functions of Moreno's 15-minute city model (Health Care, Education, Work, Entertainment, Habitat and Provisioning). It was deemed pertinent to incorporate the dimensions of public services and public spaces, thereby emphasizing the public dimension in the context of supporting normative urban planning. Furthermore, it is important to acknowledge that the public city dimension is central to the concept of proximity, manifesting itself through urban public spaces and commons.

The evaluation of the corpus reveals significant variability in the choice of functions studied. Some functions are recurrent, including the most represented: provisioning (retail), health, education, and leisure. Secondary functions include public spaces, housing, and administrative services. Finally, the "work" function remains largely marginalized in analyses, despite its importance in citizens' daily lives. Yet, commuting between home and work constitutes a major obstacle to the realization of the "15-minute" model, as noted by López García de Leániz and Fernández Lobo (2023). Two strategies could facilitate its consideration: bringing workplaces closer to residential areas or developing proximity mobility solutions to prevent commuting from becoming a constraint. Regarding the number of functions analysed, nearly half of the articles (23 out of 47) include between 6 and 8 functions, reflecting a multi-criteria approach. Eleven articles focus exclusively on a single function. For example, Zhang et al. (2023a) analyse spatial accessibility to urban parks in Guangzhou, revealing inequalities in access across different city areas.

4.1.3. Dominant research domains

After reviewing the entire corpus, several major disciplines emerged as complementary typologies for cross-sectional analysis. Scientific discipline is defined here as a relevant criterion, as it reflects both the field practiced by the members of the research groups and the perspective adopted by the methodologies employed. Six main disciplines were thus identified: urban planning; geography, often social or environmental, which allows it to be distinguished from urban planning approaches more oriented toward architecture and civil engineering; transport studies; technology, encompassing computer science, mathematics, statistics, and related techniques; engineering, particularly in the field of civil infrastructure; and public administration, including, in some cases, measurability studies initiated and funded by public institutions. The "other" category encompasses less common approaches, such as the use of neuroscience and cognitive sciences in a study by Zhang et al. (2023b). Although it does not constitute a standalone category, being present in only one article, its inclusion highlights the growing disciplinary openness of urban studies.

Special attention was given to the main disciplines in each study when reviewing the corpus. Of the 47 documents analysed, 24 fall within urban planning, while 27 and 17 display engineering and technological characteristics, respectively. In total, 36 articles can therefore be classified as adopting a technological and/or engineering perspective. At a secondary level, contributions stem from geography (10), transport studies (9), and public administration (8).

The evaluation of existing approaches reveals a pronounced disciplinary imbalance in the design of indicators, which remains largely dominated by engineering. This is not to deny the relevance of the technical contributions provided by engineers, which constitute a valuable perspective for territorial diagnosis. However, this contribution would benefit from being systematically complemented by perspectives from urban planning, social geography, or urban sociology, to produce diagnoses more firmly grounded in territorial realities. These findings highlight the predominance of a technocentric approach to measuring proximity and underscore the lack of genuinely operational tools to inform public decision-making.

4.2. Complementary methodological dimensions

4.2.1. Citizen Participation

A vast majority of the approaches reviewed are structured according to top-down logics, based on expert definitions of proximity, without directly involving users or residents. The services and functions selected to construct proximity matrices predominantly rely on an interpretation of essential social functions proposed by Moreno (2021), namely: recreation, self-care, provisioning, learning, work, and residence. However, some approaches have begun to incorporate citizen consultation processes. Notably, the 20-Minute Neighbourhoods project conducted an online survey among neighborhood planning groups. Participants were asked to indicate which facilities they believed should ideally be located within a 10-minute walk from their homes. The results allowed the development of a localized service matrix, which then served as the basis for proximity mapping (Mott MacDonald & Leeds City Council, 2022).

4.2.2. Sources and Nature of Data Used

Urban proximity measurement approaches rely on heterogeneous data sources, reflecting territorial contexts, researchers' methodological choices, and conditions of access to geographic data. Three main categories of sources can be distinguished: local data, global open data, and mixed models combining multiple sources. Local data provide contextual precision but may be constrained by institutional openness. Some studies rely exclusively on databases produced by local authorities or national agencies. These data are generally structured, validated, and adapted to local contexts, making them valuable for detailed and operational analyses. For example, in her study of Turin, Staricco (2022) selects only sub-indicators available on the municipal open data platform, provided they are georeferenced and usable within a GIS framework. This approach ensures coherence with local urban planning tools but remains dependent on the quality, availability, and accessibility of data provided by competent authorities.

Global open data makes it possible to standardise accessibility methods at the international level. Some studies rely on globally available sources, particularly OpenStreetMap (OSM), which has become a reference in studies of service accessibility. OSM offers global coverage, a standardized data structure, and customizable extraction options via tools such as the Overpass API or the Python library OSMnx. Several studies in the corpus (Olivari et al., 2023; Caselli et al., 2022) rely almost exclusively on OSM data. These works demonstrate that the OSM ecosystem now constitutes an open, accessible, and adaptable geographic data infrastructure, particularly relevant for proximity analysis in contexts where official data are absent or difficult to access. Another advantage of this approach is its reproducibility, allowing methods to be replicated across different territories and facilitating international comparisons.

Finally, several studies adopt a mixed approach, combining local data, open data, and sometimes proprietary data. This hybridization helps overcome the limitations of each source and enriches the method. In their study of Naples, Gaglione (2021) combines statistical data from the Italian National Institute of Statistics (notably population density), Google Maps data (e.g., sidewalk width or travel times), and OSM data for service locations. Similarly, Carot Sierra & Villalba Ortiz integrate local municipal data from Valencia with OpenStreetMap data extracted via the Python OSMnx API. This strategy provides broader functional coverage and greater spatial reliability while maintaining methodological flexibility. However, it raises issues of data compatibility and currency.

Beyond the methodological typologies already documented in the literature—particularly the six major categories established by Megahed et al. (2024)—this section focuses on exploring the breadth of technical and analytical criteria employed to represent and characterize urban proximity. The aim is not to propose an additional typology, but rather to highlight the diversity of possible configurations in the design of indicators.

4.3. Complementary analysis: calculation criteria and spatial transcription

4.3.1. Isochrone Calculation Methods

Proximity is predominantly measured using isochrones, which represent the area accessible from a given point within a specified travel time. Their use allows analyses to move beyond simple metric buffers and better reflect the constraints of street networks. Isochrones may be metric, based on standardized distances, or temporal, relying on

actual travel times calculated according to network conditions and mobility assumptions. This distinction influences the interpretation of accessibility and the comparability of results across studies.

4.3.2. Mobility Modes and User Profiles

The mobility modes integrated into calculations vary across studies and include walking, cycling, and public transport. Some approaches further differentiate user profiles by incorporating perceived constraints such as comfort, safety, age, or specific cognitive experiences of urban space (Capasso Da Silva et al., 2020; Willberg et al., 2023). These adaptations introduce an equity dimension into proximity assessments by recognizing that accessibility is experienced differently across population groups.

4.3.3. Spatial Starting Points for Calculations

Two approaches prevail in the literature. The first takes services themselves as starting points and evaluates their catchment areas, while the second begins from residents or community reference points to assess the accessibility of surrounding amenities. This distinction reflects different understandings of proximity: a user-centred logic focused on daily accessibility versus a service-oriented logic concerned with the reach and attractiveness of facilities. The choice of starting point ultimately shapes the interpretation of results and their implications for planning decisions.

4.3.4. Service Weighting Logic

Some models introduce weighting systems that differentiate services according to socio-demographic characteristics, thereby incorporating equity considerations into proximity measurement. This approach challenges the assumption that all amenities have equivalent value in everyday life. The relative importance of services varies according to household characteristics and needs, raising the question of which functions should be prioritized within calculation matrices. Addressing this issue requires combining objective indicators with more qualitative understandings of residents' practices and preferences.

4.3.5. Cartographic Representations and Result Formats

Result formats vary considerably across methodologies. Standardized grid representations, particularly hexagonal grids, facilitate comparison across territories and are frequently used to translate proximity indicators into operational diagnostics. Other approaches generate accessibility indices or heatmaps that can be combined with socio-demographic information to identify spatial inequalities. These visual outputs are often complemented by statistical summaries that quantify the distribution of accessibility levels across the study area.

4.3.6. Study Scales in Methodologies

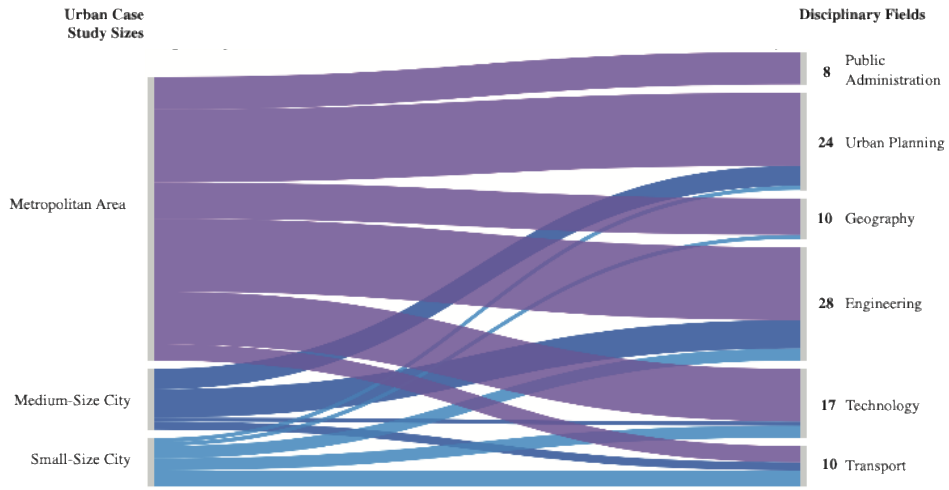

Figure 4. Sankey representation of the relationship between urban case study size and disciplinary fields in the analysed corpus.

The scale at which proximity indicators are applied constitutes a major methodological challenge. At the micro-local level, indicators often support contextualized diagnostics associated with urban regeneration projects. At the neighbourhood scale, they are used to identify service gaps, support active mobility, and guide public investment. Conversely, regional or international indices aim to compare urban performance across large numbers of cities using standardized datasets. While these broader approaches facilitate benchmarking, they may obscure local specificities and reduce the operational relevance of results. The challenge therefore lies in adapting indicators to the scale of public action and to the institutional capacities of each territory.

4.3.7. Urban Contexts Studied: A Shortage of Medium-Sized Urban Systems

The reviewed studies focus predominantly on large metropolitan areas, where institutional capacities facilitate the implementation of sophisticated analytical frameworks. Of the 47 studies included in the corpus, 35 concern cities with more than 400,000 inhabitants. This imbalance raises questions regarding the transferability of existing methodologies to medium-sized cities, despite their importance within European urban systems. Frequently characterized by polycentric structures inherited from historically autonomous centres, these contexts generate specific tensions between multiple centralities and challenge linear models of accessibility. Their diversity calls for a more context-sensitive adaptation of proximity indicators.

5. Results

5.1. Critical observations from the comparative analysis

This situation highlights three significant gaps that may hinder the development of an integrated approach to urban proximity.

First, there is a clear disciplinary compartmentalization: most indicators are developed by engineers or specialized technicians using cartographic and quantitative methodologies that are often disconnected from the social, morphological, or perceptual realities of urban space. As a result, proximity tends to become a methodological pretext rather than the central objective of the analysis. This technical focus produces a fragmented perspective that may fail to provide a sufficiently nuanced understanding of the studied territories' propensity for proximity and, consequently, cannot support the formulation of appropriately operational strategies.

Second, there is a lack of a shared conceptual framework. The 15-minute city concept, frequently mobilized as a slogan, remains vague in its operational definition. Its temporal and spatial flexibility—whether framed as an X-minute city per person, per neighborhood, or per city—renders it adaptable, but it also requires greater rigor in defining spatio-temporal metrics to ensure consistency and comparability.

Third, there is limited attention given to European medium-sized cities. These cities are often characterized by polycentric organization and by tensions between secondary centers and the city core, necessitating the development of specific indicators. Servillo et al. (2017) highlight that medium-sized cities play a key role in the European urban system, serving as regional hubs for services and economic activity. Considering proximity in such contexts involves reconciling the needs of densely urbanized areas with those of semi-rural peripheries, considering accessibility, services, and usage patterns that differ substantially from metropolitan standards. Understanding the polycentric systems of medium-sized cities therefore entails identifying and reinforcing structuring connections that support cohesion and functional integration.

It should be recalled, however, that these observations are based on a sample of studies and should not be interpreted as an exhaustive reflection of scientific or professional reality. The diagram presented, developed using the Sankey method (**Figure 4**), illustrates—based on the corpus under review—the disciplinary distribution of methodologies mobilized according to different types of urban case studies. The analysis of this corpus highlights a clear gap in the articulation between urban planning and medium- or small-sized cities, particularly regarding the measurement of proximity. The approaches identified also reveal a predominance of technical and engineering dimensions, largely oriented toward metropolitan contexts. Furthermore, the administrative and institutional dimension is notably absent from studies focusing on small and medium-sized cities, which raises questions about the degree of interest shown by public planning authorities in funding research related to urban proximity. Finally, the disciplines of geography and transport do not appear to provide significant complementary insights to these findings. Considering these results, it seems relevant to situate the scientific inquiry precisely where this gap emerges: in the strategy of the 'city of proximity' through the lens of urban planning, applied to the scale of medium-sized cities. The principal findings emerging from the comparative analysis are synthesized in **Table 1**, which highlights how the evidence gathered from the analytical corpus informs the research implications and progressively supports the development of the Integrated Proximity Matrix.

Table 1. Main findings emerging from the comparative analysis and their implications for the Integrated Proximity Matrix.

	Evidence from the comparative analysis	Implication for proximity assessment	Contribution of the Integrated Proximity Matrix
Disciplinary fragmentation	Engineering (27 studies) and urban planning (24 studies) dominate the corpus, while geography (10) and transport (9) remain comparatively less represented. Approaches are generally developed within a single disciplinary perspective.	Measurement should reconnect planning and spatial analysis. Urban proximity requires a more integrated planning perspective.	Integration of functional, spatial and qualitative dimensions.
Conceptual heterogeneity	The corpus includes multiple temporal models (10-, 15-, 20-, 45-minute), heterogeneous indicators, diverse spatial units and several accessibility calculation methods.	Proximity should be understood as multidimensional. No single indicator can adequately capture urban proximity.	Integration of complementary dimensions within a common conceptual architecture.
Limited consideration of Medium-sized European cities	Metropolitan contexts represent 35 case studies, compared with only 8 medium-sized and 4 small cities.	Assessment should be context-sensitive. Existing methodologies require adaptation to polycentric medium-sized cities.	Adaptability of the framework to polycentric medium-sized cities. Development of a flexible framework supporting context-sensitive implementation.

5.2. From proximity measurement to an integrated conceptual framework

The measurability phase provides a useful initial basis for diagnosing service accessibility and constitutes a necessary first step. However, cartographic realisations should not be considered an end. It must be regarded as the starting point for a strategic approach aimed at transforming a diagnostic into actionable measures. This work thus proposes the preliminary outlines of an integrated proximity matrix, structured around a dual objective: to develop a spatial diagnostic tool for proximity (in its physical and relational dimensions) and to translate this diagnosis into normative arrangements adapted to territorial planning. Such an approach requires:

1. Weighting services according to their urban function (basic local services versus structuring services at the urban scale). It is possible to design a spatially weighted matrix for services (**Figure 5**). Indeed, services can be considered along a spatial dimension, ranging from a neighborhood scale—where a maximum walking time of 15 minutes may be considered acceptable—to an urban scale, where walking time could exceed this threshold (Gaglione et al., 2024). Similarly, some services appear more essential than others depending on the scale considered. For instance, in the healthcare sector, a pharmacy at the neighborhood scale seems to be more important than a cosmetic clinic. Conversely, a hospital, which primarily operates at an urban scale, plays a major role at this scale rather than at the neighborhood scale.
2. Integration of the pedestrian and cycling network, excluding inaccessible routes
3. Use of a grid-based method, particularly relevant for representing proximity across the entire study area.
4. Demographic assessment integrated into the grid-based structure, based on census data
5. Inclusion of qualitative indicators, either as sub-indicators or as filters for a layered interpretation of the territory
6. Some amenities, such as urban parks, require methodological adjustments. Knap et al. (2023), for instance, propose converting polygons into access points (entrances connected to the street network) to improve the accuracy of spatial analysis.

Taken together, these methodological observations suggest that urban proximity cannot be adequately captured through a single indicator or analytical dimension. Instead, the comparative analysis demonstrates that existing proximity assessment approaches capture complementary dimensions of an inherently multidimensional concept. The principal contribution of this study therefore lies not in proposing a new proximity indicator, but in shifting the perspective on proximity assessment by recognizing the need for an integrated conceptual framework capable of articulating these complementary dimensions.

Conceptually, **Figure 6** links the spatial dimension of the four planning scales — from the residential area to the regional scale, including the neighborhood and urban scales — with the temporal dimension, through conceptual buffers defined according to modes of mobility (walking, cycling, and public transport). These buffers can subsequently be translated into isochrones within the framework of spatial computation. This approach highlights the interaction between spatial and temporal dimensions, which evolve under the influence of mobility, acting as a key enabler of urban proximity.

A spatial typology can help guide strategies by identifying three situations: balance (dense areas with good service coverage), abundance (low density with good service coverage), and deficiency (dense areas with poor service coverage). Two strategic hypotheses can be derived from this framework. In areas of abundance, interventions could focus on improving the quality of public space, enhancing soft mobility connections, or increasing walkability to reactivate proximity. In areas of deficiency, strategies might either strengthen the network through mobility plans or direct zoning and development according to identified gaps.

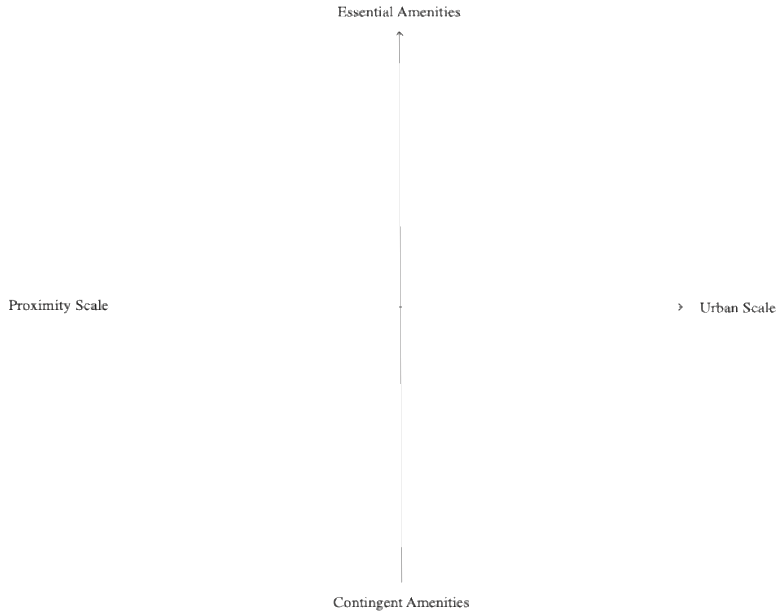

Figure 5. Spatial scale weighting matrix.

The ongoing doctoral research explores the possibility of normatively embedding a proximity strategy within the Piano Operativo of the city of Prato, a polycentric medium-sized city in Tuscany. This approach relies on three complementary avenues. First, urban design, through spatial forms that promote both functional and relational proximity. Second, regulatory instruments, via a "transect" type approach with differentiated norms according to centralities, aimed at ensuring functional completeness of neighborhoods and limiting motorized travel. Finally, promotion of local initiatives seeks to consolidate social practices rooted in specific places. The objective is to move beyond the 15-minute city as a mere slogan and to transform it into a tangible, spatially equipped framework capable of guiding planning in non-metropolitan contexts. These research directions provide the operational perspective within which the conceptual framework developed in this article will subsequently be implemented and empirically evaluated.

5.3. Integrated Proximity Matrix: a conceptual synthesis

Figure 7 presents the Integrated Proximity Matrix, which constitutes the conceptual synthesis emerging from the comparative analysis conducted throughout this study. The matrix did not emerge as an a priori conceptual model; rather, it was progressively constructed from the recurring methodological dimensions identified across the analytical corpus. Its structure derives from the recurring methodological dimensions identified throughout the comparative analysis—including spatial scales, urban functions, assessment indicators, mobility patterns, demographic considerations, and qualitative dimensions—which are progressively articulated into an integrated conceptual architecture.

Rather than proposing a new proximity indicator or a finalized operational methodology, the matrix formalizes the central research proposition advanced in this article: urban proximity can only become an effective planning tool if its assessment relies on an integrated and multidimensional conceptual architecture. In this sense, the matrix does not replace existing assessment approaches but articulates their complementary contributions within a common conceptual framework. The Integrated Proximity Matrix therefore represents the conceptual outcome of this study rather than its endpoint. It acts as the bridge between the comparative findings presented in this article and the subsequent development and empirical validation of a context-sensitive proximity assessment methodology within the ongoing doctoral research conducted in Prato.

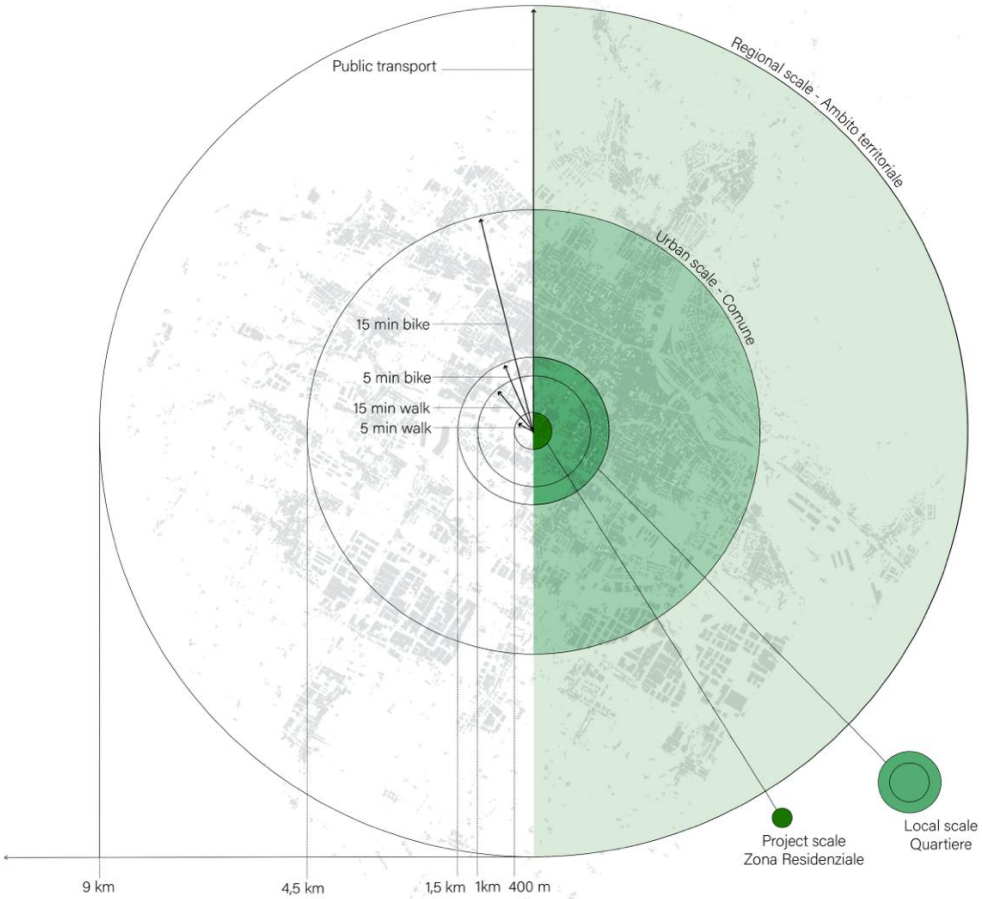

Figure 6. Conceptual representation of Proximity Metrics.

6. Conclusion

This work does not claim to be exhaustive; rather, it constitutes an exploratory entry point for examining the conditions under which spatial diagnostics can support proximity-oriented planning strategies. It carries several limitations inherent to its scope, posture, and analytical choices. The corpus analysed is necessarily partial and would benefit from being complemented by qualitative, participatory, or ethnographic approaches capable of refining territorial diagnostics and capturing lived experiences of proximity. Nevertheless, the measurement of proximity has the potential to serve as a shared space for dialogue among researchers, practitioners, policymakers, and citizens.

By critically reviewing existing measurement approaches, highlighting the specific challenges faced by European medium-sized polycentric cities, and proposing an Integrated Proximity Matrix as an exploratory framework, this article seeks to contribute to the ongoing operationalization of proximity-based planning. The Integrated Proximity Matrix should therefore be interpreted as a conceptual and diagnostic device rather than as a ready-to-use methodology. The next stage of this research consists of testing this multidimensional analytical framework in Prato, considered here as a prospective field for experimentation rather than as evidence of validation.

Recognizing the plurality of approaches surrounding the 15-Minute City allows for the identification of a conceptual and operational continuum. This process is grounded in a strong conviction: the measurability of proximity is not a purely technical exercise, but a process of translation between diagnosis, spatial design, and territorial regulation. It requires a situated and integrated approach that is sensitive to the specificities of European medium-sized cities, which may represent one of the key levers for the future transformation of more sustainable urban systems.

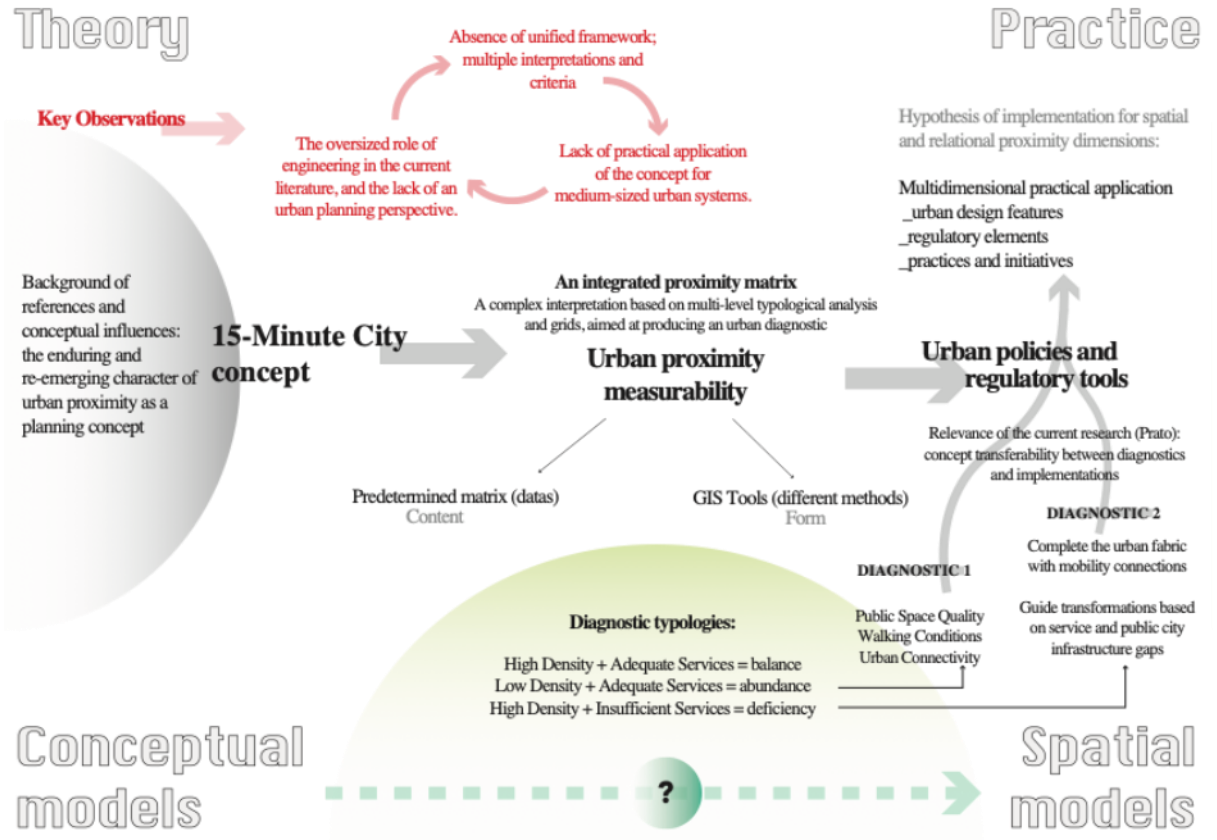

Figure 7. Integrated Proximity Matrix.

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Ethics Approval

Not applicable.

Conflict of Interest

The author declares that there are no known competing financial or personal interests that could have appeared to influence the work reported in this paper.

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6. Appendices

Appendix A. Analytical corpus of proximity assessment methodologies

Journal Articles

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Appendix B: Two cross-sectional tables of the study corpus according to the three criteria

Table B1: Urban Case Study Sizes and Disciplinary Fields

Authors references	Study area	Urban Case Study Sizes			Disciplinary Fields						
		50,000– 200,000	200,000– 500,000	>500,000	Urban Planning	Geography	Transport	Technology	Engineering	Public Admin.	Other
Ulloa-Leon et al.	Santiago			●		●			●		
Luca Staricco	Turin			●	●						
Balletto et al.	Cagliari-Brescia	●							●		
López García de Leániza & Fernández Lobo	Madrid			●			●	●	●		
Sony Computer Science	World			●				●			
Bureau of Planning and Sustainability of Portland	Portland			●				●		●	
Graells-Garrido et al.	Barcelone			●	●			●	●		
Knap et al.	Utrecht		●				●	●	●		
Capasso Da Silva et al.	Tempe (AZ)	●			●				●		
Olivari et al.	Ferrara-Bologna	●	●				●	●	●		
Luo et al.	Zhengzhou			●		●		●	●		
Zhang et al. (2023a)	Guangzhou			●	●						
Wang et al.	Beijing-Guangzhou			●		●			●	●	
Ferrer-Ortiz et al.	Barcelone			●		●	●	●			
Badii et al.	Florence		●				●	●			
Guzman et al. (2021)	Bogotà			●	●				●		
Zhang et al. (2023b)	Shanghai			●	●						●
Hachette et al.	Strasbourg		●			●			●		
Mariotti et al.	Milan			●	●						
Caselli et al.	Parma	●			●				●		
Barbieri et al.	Rome-Paris-London			●	●				●		
Song et al.	China			●		●		●			
Abd El Karim & Awawdeh	Buraidah			●					●	●	
Guzman et al. (2024)	Bogotà			●	●				●		
Leeds City Council	Leeds			●					●	●	
Hölzel et al.	Germany			●					●		
Lanza et al.	Bologna		●		●		●				
Rossetti et al.	Brescia	●			●				●		
Vich et al.	Barcelone			●		●		●		●	
Balletto et al.	Stadio Cagliari	●					●		●		
Harroucha & Chaouni	Fez			●				●			
IziLab	Roma			●				●	●		
Li et al.	Baoding City			●	●						
Abdelfattah et al.	Milan			●	●		●		●		
Di Marino et al.	Oslo-Lisbon			●	●			●	●	●	
Willberg et al.	Helsinki			●	●	●		●			
Noworól et al.	Krakow			●	●					●	
Weng et al.	Shanghai			●				●	●		
Calafiore et al.	Liverpool			●	●	●					
Kesarovski & Hernández-Palacio	Stavanger	●			●						
Liu et al.	Hong Kong			●		●			●		

Table B2: Urban Amenities

Authors references	Study area	Urban Amenities							
		Health Care	Education	Work	Entertainment	Public spaces	Habitat	Provisioning	Public services
Ulloa-Leon et al.	Santiago					●			
Luca Staricco	Turin	●							
Balletto et al.	Cagliari-Brescia	●	●		●		●	●	
López García de Leániza & Fernández Lobo	Madrid	●	●		●	●	●	●	
Sony Computer Science	World	●	●	●	●		●	●	●
Bureau of Planning and Sustainability of Portland	Portland	●	●		●	●	●	●	
Graells-Garrido et al.	Barcelone	●	●		●	●		●	●
Knap et al.	Utrecht	●	●	●	●	●	●	●	
Capasso Da Silva et al.	Tempe (AZ)	●	●		●	●	●	●	●
Olivari et al.	Ferrara-Bologna	●	●	●	●	●	●	●	
Luo et al.	Zhengzhou		●			●		●	
Zhang et al. (2023a)	Guangzhou							●	
Wang et al.	Beijing-Guangzhou					●			
Ferrer-Ortiz et al.	Barcelone	●	●	●	●	●	●	●	●
Badii et al.	Florence	●	●		●	●	●	●	●
Guzman et al. (2021)	Bogotà	●			●	●		●	
Zhang et al. (2023b)	Shanghai							●	
Hachette et al.	Strasbourg	●							
Mariotti et al.	Milan						●		
Caselli et al.	Parma	●	●		●	●	●	●	●
Barbieri et al.	Rome-Paris-London	●	●			●	●	●	
Song et al.	China				●				
Abd El Karim & Awawdeh	Buraidah	●	●		●	●	●		
Guzman et al. (2024)	Bogotà	●	●		●	●		●	●
Leeds City Council	Leeds	●	●		●	●	●	●	
Hölzel et al.	Germany	●	●	●				●	
Lanza et al.	Bologna	●	●		●	●	●	●	●
Rossetti et al.	Brescia	●	●	●	●		●	●	●
Vich et al.	Barcelone	●	●		●	●	●	●	●
Balletto et al.	Stadio Cagliari	●	●		●		●	●	
Harroucha & Chaouni	Fez	●	●		●			●	
IziLab	Roma	●	●	●	●		●	●	●
Li et al.	Baoding City	●	●		●	●		●	●
Abdelfattah et al.	Milan			●	●		●	●	●
Di Marino et al.	Oslo-Lisbon		●		●	●		●	
Willberg et al.	Helsinki					●			
Noworól et al.	Krakow				●				
Weng et al.	Shanghai	●	●		●	●		●	●
Calafiore et al.	Liverpool	●	●	●	●	●		●	
Kesarovski & Hernández-Palacio	Stavanger	●						●	●
Liu et al.	Hong Kong	●						●	●