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Indicators for Urban Liveability and Sustainability

Erol, Aylin; Cardinali, Marcel; Kost, Susanne; Pottgiesser, Uta

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A Systematic Review of the 15-Minute City Concept: Indicators for Urban Liveability and Sustainability

Aylin Erol[1*)], Marcel Cardinali[2)], Susanne Kost[3)], Uta Pottgiesser[4,5)]

[1*)] Institute for Design Strategies, OWL University of Applied Sciences and Arts (TH OWL), Germany, aylin.erol@stud.th-owl.de; https://orcid.org/0009-0006-0103-6461
[2)] Institute for Design Strategies, OWL University of Applied Sciences and Arts (TH OWL), Germany, marcel.cardinali@th-owl.de; https://orcid.org/0000-0002-8841-9345
[3)] Detmold School of Design, OWL University of Applied Sciences and Arts (TH OWL), Germany, susanne.kost@th-owl.de; https://orcid.org/0009-0001-5461-2278
[4)] Institute for Design Strategies, OWL University of Applied Sciences and Arts (TH OWL), Germany, uta.pottgiesser@th-owl.de; https://orcid.org/0000-0002-8594-3168
[5)] Faculty of Architecture and the Built Environment, TU Delft, The Netherlands, u.pottgiesser@tudelft.nl; https://orcid.org/0000-0002-8594-3168

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Abstract

Urban transformation and urban preservation are often seen as contradicting goals. Currently, there is no agreed-upon strategy on how to transform historic parts of the city while maintaining their heritage values. Many cities today are characterised by modern 20th-century heritage, yet it poses a challenge to their liveability and to the adoption of less car-dependent lifestyles. The concept of 15-minute cities can be used to improve urban liveability, which may positively affect the experience and functionality of modern historic urban landscapes (HUL). A review of the existing literature on the 15-minute city concept was carried out with the aim of identifying its key indicators and proposing possible new ones. This research primarily explores how the 15-minute city concept can be applied holistically and efficiently in modern heritage. Following the PRISMA guidelines, 20 articles published after the introduction of the concept and meeting the inclusion criteria in the Scopus and Web of Science (WoS) databases were reviewed. Selected examples and case studies are analysed to contextualise these variables and explore how they can be reflected in modern historic urban landscapes. As a result, the following variables are identified as central to the 15-minute city concept: mobility, time, distance, speed, functions of the amenities each with their associated indicators. Moreover, spatial characteristics, human-centred factors and heritage values are proposed as variables. The results are expected to give insights into how to operationalise the concept of 15-minute cities in modern sites of historic urban landscapes, in order to improve liveability while simultaneously preserving its values. This research contributes to the Sustainable Development Goals (SDGs) by promoting walkable, climate-resilient neighbourhoods. In particular, it aligns with SDG Target 11.4, which focuses on cultural and natural heritage.

Keywords: *15-minute city, historic urban landscapes, (HUL), Sustainable Development Goals (SDGs), heritage, modernism, urban indicators*

1. Introduction

According to the United Nations Climate Action, one of the causes of climate change is transportation. Most of the cars, trucks, ships, and planes run on fossil fuels, which makes transportation a major contributor of greenhouse gases, especially carbon dioxide emissions [1]. Next to their emissions, car-dependent urban designs and infrastructures negatively influence the liveability of cities. Thus, it's crucial to reduce car-dependent design strategies in order to create resilient cities and address environmental, economic and societal challenges. Furthermore, in 2015, the 2030 Agenda for Sustainable Development was adopted by all United Nations Member States and declared 17 Sustainable Development Goals (SDGs). Goal 11 has a specific focus on ''sustainable cities and communities'' [2]. Since the foundation of SDGs, from students to chief executives, and from city governments to state administrations, leaders at various levels are increasingly adopting the SDGs to establish sustainable societies. Pottgiesser et al. [3] emphasise how theoretical findings on heritage and SDGs engage with heritage practice by examining the theories, methodologies, and practices since the SDGs' target 11.4 is oriented towards the relationship between heritage and sustainability.

A number of urban concepts, such as Superblocks (Barcelona), low traffic neighbourhoods (London), 15-minute cities (Paris), car free cities (Freiburg), or a combination of these, are being adopted in various cities to address these environmental and societal concerns to some extent. What these models have in common is that they strive to reduce private car usage while increasing public and active transportation (walking and cycling), reducing air pollution, noise, and heat island impacts, and increasing physical activity, all of which promote and improve health [4]. The 15-minute city concept was initially proposed by Carlos Moreno in 2016, with the idea that in less than 15 minutes, an inhabitant can access his or her basic living needs [5]. The 15-minute city is based on the "chrono-urbanism" theory, which holds that the quality of urban life is inversely related to the amount of time spent on transportation, particularly when using a vehicle. The author favours an urban environment in which residents can get all fundamental necessities at distances that would take them no more than 15 minutes by foot or by bicycle. According to Moreno, the 15-minute city allows residents to enjoy a higher quality of life by ensuring access to six essential urban functions: living, working, commerce, healthcare, education, and entertainment. After observing the challenges faced by cities worldwide during the peak of COVID-19, Moreno et al. proposed four key dimensions. These dimensions form the basis of the proposed "modified 15-Minute City" framework, which builds upon Moreno's original concept. The identified dimensions include density, proximity, diversity, and digitalization. While the dimension of density is defined by the number of people per kilometre square, the

dimension of proximity considers both temporal and spatial aspects within the 15-minute, residents can easily reach essential services. The diversity dimension is defined on two levels by promoting mixed-use neighbourhoods that integrate residential, commercial, and entertainment spaces as well as fostering diversity in culture and people. The dimension of digitalisation, aligns closely with the Smart City concept, from which the 15-Minute City framework can be seen as partially inspired [6].

However, due to the contradicting nature of urban transformation and urban preservation there is no agreed-upon strategy on how to transform historic parts of the city while maintaining their heritage values. Contemporary urban planning policies often neglect the integration of historic layers and sites into the urban fabric of the city. In a lot of cities, the historic districts from the 18th to 19th century attract a lot of interest, despite all street space being dedicated to cars. In contrast, modern 20th-century districts are often avoided and criticised, and challenge the liveability and the adoption of less car-dependent lifestyles. The historic urban landscape (HUL) approach, adopted by UNESCO's General Conference, asserts that beyond the preservation of the physical environment, the entire human environment should be considered with all of its tangible and intangible qualities. HUL is defined as a result of a historic layering of cultural and natural assets and features, expanding beyond the notions of "historic centre" or "ensemble" to embrace the larger urban context and its geographical location [7]. The urban fabric dating from before the invention of cars is relatively easier to revert back to a 15-minute city model, where everything is close by and accessible within a 15-minute walk or bike ride, as can be seen in the historic districts of Copenhagen, Paris, and Barcelona. However, the urban fabric of the 20th century is much more complex to preserve since the car-centrality is built into it. The focus on vehicular dominance often shaped contemporary urban planning decisions to prioritise automobile-centric design, while urban theorists such as Jacobs [8] and Gehl [9] among others were against the idea of car-dependent cities. As a result, modern parts of HUL may not be easily accessible or seamlessly connected to pedestrian pathways and public spaces. The limited focus on human-scale experiences may lead to a less positive experience of these layers among citizens.

To address these threats, it is crucial to adopt a more future-proof sustainable development approach for preserving, redesigning, and adapting the built environment while implementing the 15-minute city concept. To contribute, this systematic literature review will focus on the idea of operationalising the 15-minute city concept to highlight the possible relation of implementation to preserve modern sites of HUL to create walkable, climate-resilient neighbourhoods and contribute to the SDGs.

This review addresses this gap by synthesizing available literature on 15-minute cities and their possible relation to urban preservation. The primary objective of this literature review is to examine existing research on the 15-minute city concepts in relation to modern heritage. It aims to provide an overview of the current state of knowledge and addresses the following research questions:

- Which past urban planning concepts are related to the 15-minute city concept?
- What are the variables and indicators of the 15-minute city concept?
- What are the gaps in the current understanding or implementation of the 15-minute city?

2. Methodology

The literature reviewed in this study was identified using procedures aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA) [10, 11]. Inclusion and exclusion criteria were applied to ensure relevance and quality. The search strategy was adapted accordingly, while still maintaining a systematic and transparent approach. To understand how 15-minute city is related to historic or modern heritage studies the research strategy below is defined:

(("15-minute city" OR "10-minute city" OR "20-minute city" OR "x-minute city" OR "15-minute neighbourhood") AND ("historic urban landscape" OR "HUL" OR "historic centre" OR "historic city" OR "historic core" OR "historical" OR "historic" OR "heritage" OR "modern heritage" OR "modern" OR "modernist" OR "modernism"))

33 documents were found with the above search string in Scopus on 19.03.2025. 18 documents were found in Web of Science. 15 duplicated results were removed and snowballing references added. After reviewing and excluding the papers final set of articles is listed. The table below indicates the references that were included in the systematic literature review (Table 1). Those papers are selected that have results or discussions related to modernism, historic city, within the scope of the 15-minute city concept. Excluded papers are noted down with the exclusion reason below:

- Reason 1: no clear methodology and explicit analyses of the case study
- Reason 2: no information on modern, heritage, or historic-related discussions and key findings
- Reason 3: Full-text not accessible
- Reason 4: Not written in English

Tab. 1. Authors and case studies included in the systematic literature review.

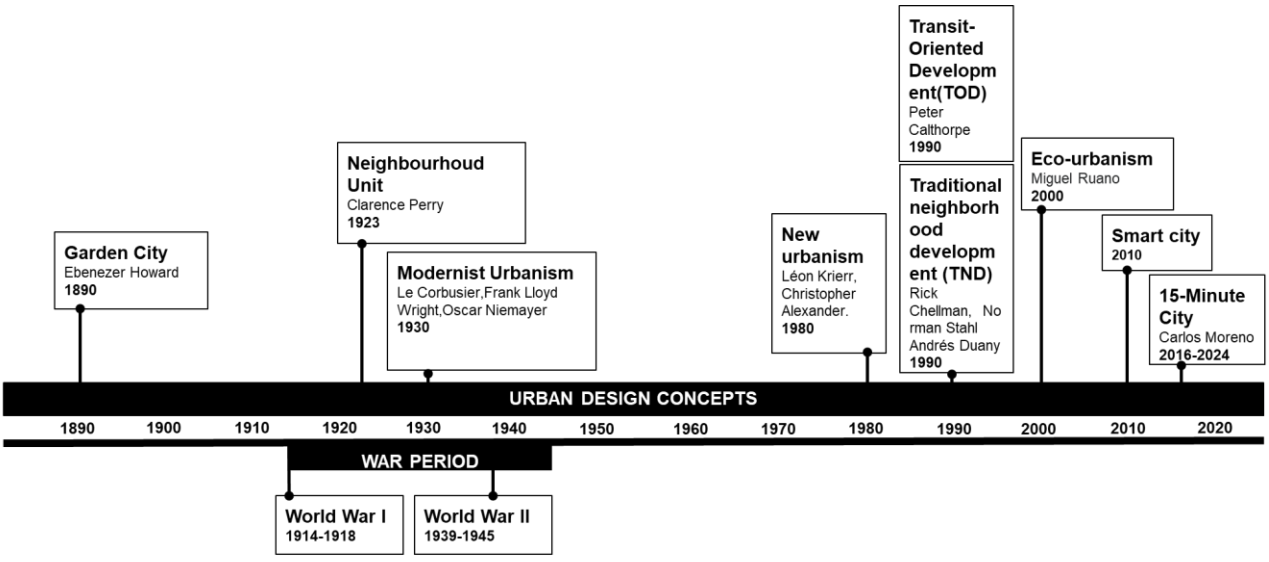
Number	Authors	Case Study
1	Logan et al. (2022)	US & New Zealand
2	Guzman et al. (2021)	Bogotá
3	Abdelfattah et al., (2022)	Milan
4	(Khavarian-Garmsir, Sharifi, & Sadeghi, 2023)	n/a
5	Papadopoulos et al. (2023)	n/a
6	Alberti et al., (2023)	n/a
7	Khavarian-Garmsir, Sharifi, Hajian Hossein Abadi, et al., (2023)	n/a
8	Allam et all. (2023)	n/a
9	Kissfazekas (2022)	Budapest
10	Balletto et al., (2021)	Cagliari
11	Staricco (2022)	Turin
12	Vilhelmson & Elldér (2021)	Gothenburg
13	Ferrer-Ortiz et al. (2022)	Barcelona
14	Noworól et al. (2022)	Krakow
15	Liu et al. (2024)	Hong Kong
16	Abbiasov et al.	US
17	Samson & Freudendal-Pedersen (2022)	Anonymous
18	Stangel & Drobniak (2024)	Katowice
19	Sezer et al. (2024)	Palermo
20	Gonyukhov & Sheludkov (2024)	Krasnodar, Naberezhnye Chelny, Saratov

3. Results and Discussion

This section aims to provide an overview of the current state of knowledge on the 15-minute city concept by addressing the three key research questions. First, it explores which historical urban planning concepts are related to the idea of the 15-minute city, identifying connections and continuities in previous urban design practices. Second, it examines the key variables and indicators used to define and assess the 15-minute city. Finally, it discusses existing gaps in the current understanding and implementation of the 15-minute city concept, highlighting areas where further research is needed.

3.1. Urban Planning Concepts Behind the 15-Minute City

The 15-minute city concept is a recently developed urban planning approach; however, it has roots in earlier concepts. Alberti et al. introduce past and recent urban models for post-COVID cities from the Neighbourhood Unit to the 15-Minute City. Authors, assert that the 15-Minute City is rooted in concepts and theories developed in the 20th century which are proposed to be grouped under the umbrella term of the Proximity City, thus including Perry's Neighbourhood Unit [12], Christaller's Central Place Theory [13], Hall's Proxemics Theory [14], Calthorpe's Transit-Oriented Development [15] and Gehl's Human Scale City [9, 16][17]. Additionally, Khavarian-Garmsir et al. in their review examine key neighbourhood planning movements to identify the origins of the 15-minute city concept. These include the Garden city, Neighbourhood unit plan, modernist urbanism, post-modern urbanism, and eco-urbanism, which have emerged since the late 19th century [18]. Moreover, Allam et al. reviewed the principles and philosophies upheld by various antimodernist architects and authors. Christopher Alexander, Leon Krier, and Nikos Salingaros are among the most vocal figures on this subject, having contributed extensively to the discourse through their substantial writings, which were elaborated by the authors. With regard to the principles of "Life" and "Wholeness," Alexander argues that an urban area remains incomplete if its various elements are designed and arranged randomly, thereby undermining the concept of "Wholeness." Salingaros [19] describes a compact city as a "low-speed" urban environment that features optimal high-density living and low-rise buildings, strategically arranged to support mixed-use spaces and seamless walkability. In his vision, single-use zoning, which was prevalent in postwar planning and, in his view, contributed to urban sprawl, has no place. Instead, he advocates for a compact city that embraces alternative zoning options. A particularly influential concept is Leon Krier's "A City within a City". Rather than relocating people away from suburban and downtown areas, this approach advocates for transforming these regions to reflect the complex structure of urban environments, forming polycentric settlements. According to Krier, this model fosters human-scale attributes, including large public spaces, walkable streets, and access to essential amenities within just 10 minutes [20]. These concepts highlight how the 15-minute city builds upon a foundation of urban planning theories to address contemporary challenges (Figure 1).



Adapted by the authors from **Alberti et al., (2023), Khavarian-Garmsir, Sharifi, Hajian Hossein Abadi, et al., (2023), Allam et all. (2023).**

Fig. 1. Timeline of the previous urban planning concepts related to 15-minute city

3.2. From Concept to Practice: Operationalizing the 15-Minute City through Variables and Indicators

A review of the existing literature on the 15-minute city concept has been carried out to identify the key variables and indicators of this concept and also possible indicators could be proposed for the future implementation.

3.2.1. Mobility Variable

Mobility is one of the most significant variables in the research field.

Logan et al. measured walking access using OpenStreetMap and OpenSourceRoutingMachine to essential services in 500 U.S. cities and 43 urban areas in New Zealand [21]. Kissfazekas examines two housing estates located in Budapest, built in the 1950s under the neighbourhood unit concept, to determine which features originally considered attractive, remain valuable to owners today and which are used as marketable selling points. Their study aims to evaluate which urban design guidelines, formulated and prioritised during the planning phase, are still relevant in the eyes of the current inhabitants by analysing real estate advertisements. Authors concluded that although the easy walking accessibility of other basic facilities, such as schools and kindergartens, is still mentioned, it is no longer seen as one of the most important factors [22]. Balletto et al. analysed a subset of disused public buildings in the historic centre of Cagliari, a city located in Sardinia, Italy. In this context, a 15-minute walking distance of approximately 1,200 meters was used, as commonly referenced in the literature, to define service areas around each site, indicating the presence of essential services [23]. Abdelfattah et al. present a case study applied to the city of Milan, aiming to explore its potential to transform into a 15-minute city with adequately walkable neighbourhoods. It investigates the correlation between neighbourhood walkability and population distribution as a means to assess inequalities in walkability levels across the city [24]. Staricco has proposed a methodology to operationalize the 15-minute city concept by evaluating walking accessibility to essential services at the city level. Authors analysed the urban fabric of the city of Turin, which they broadly categorized

into three main phases of development. The first phase includes the historical city centre, developed around the original Roman core and completed by the 19th century. Surrounding this core is the first ring, constructed during the first 40 years of the 20th century. Beyond this lies the second outer ring, primarily built after the World War II, particularly in the 1950s and 1960s. By using the QGIS "Select by position" function, for each of the 20 services and for each census tract, it was calculated how many locations of that service were included in the isochrone from that census tract for the walking thresholds [25]. Vilhelmson and Elldér assess changes in proximity to essential services in the Gothenburg city region, Sweden, over the period 1994–2014. This timeframe coincides with sustainability policy goals aimed at promoting urban densification and non-motorized mobility, while simultaneously, the deregulation of public services reduced political control over their accessibility. The results indicate that services under the highest (libraries) and lowest (grocery stores) levels of public control saw a decline in proximity. Conversely, recently deregulated services, such as pharmacies and primary schools, became more accessible on foot due to disruptive market-driven changes [26]. Ferrer-Ortiz et al. develops a measuring method using network analysis for services and activities in Barcelona, Catalonia, Spain. The results indicate that Barcelona, as a dense and compact city, largely meets 15-minute city criteria, with most residents living in areas with high service accessibility. However, authors find out that peripheral areas experience some accessibility gaps. While central and historic neighbourhoods offer high levels of walking accessibility due to the distribution of local public facilities, newer developments often fall short of meeting 15-minute city standards [27]. Noworól et al. conducted a study to examine service proximity across city of Kraków, Poland, and assess the percentage of residents with access to specific facilities within 15 minutes. Their analysis aimed to identify areas providing a sufficient set of services within a 15-minute walking distance (both minimal and optimal versions) and to determine which areas face the greatest deficits in local service provision [28]. Abbiasov et al. introduces a measure of local trip behaviour by utilizing GPS data from 40 million mobile devices in the United States, defining "15-minute usage" as the proportion of consumption-related trips occurring within a 15-minute walking distance from home [29]. Stangel and Drobniak present new perspectives on the concretization and operationalization of strategies for fostering "Local Urban Centers" around planned railway stops, with a specific focus on the distinctive urban fabric of Katowice, a post-industrial city in Poland [30]. Sezer et al. introduces a methodology that integrates "Transit-Oriented Development" and the 15-minute city principles from an analytical perspective, applying them to a rail station area in Palermo, a Southern Italian city facing challenges related to inefficient public transport and traffic congestion [31]. Gonyukhov and Sheludkov analysed the pedestrian accessibility in three large and morphologically different post-Soviet cities, Krasnodar, Saratov, and Naberezhnye Chelny in Russia. Their results highlight that the highest accessibility of the facilities is observed in the historical city centres, which concentrate the facilities that provide unique and city-wide services. The Soviet micro districts show the higher accessibility values compared to modern high-rise multi-unit residential buildings, while the lowest accessibility is observed in the modern low-rise neighbourhoods. The average walking time to the basic services and facilities there is three times longer than in the historical centres, and twice as long as in the Soviet micro districts [32].

Consequently, mobility can be categorised into two indicator categories: scale of mobility and means of mobility (Figure 2). Scale of mobility is an important indicator as the definition of variables depends on whether the case study has the neighbourhood, city, regional, or country scale. Another important key indicator is the means of mobility that be classified into the two indicator sets of physical mobility and virtual mobility. While physical mobility includes walk, bike, electric kick scooter, skate, bus, train, metro, tram, car, or taxi, virtual mobility includes working from home, online shopping, banking, virtual communication as its also stated in digitalisation dimension of Moreno.

It is important to note that these variables influence urban mobility patterns and overall mobility dynamics in urban space. Among the studies, it can be concluded that although the scale of mobility varies widely, the means of mobility tend to focus on walking or public transportation.

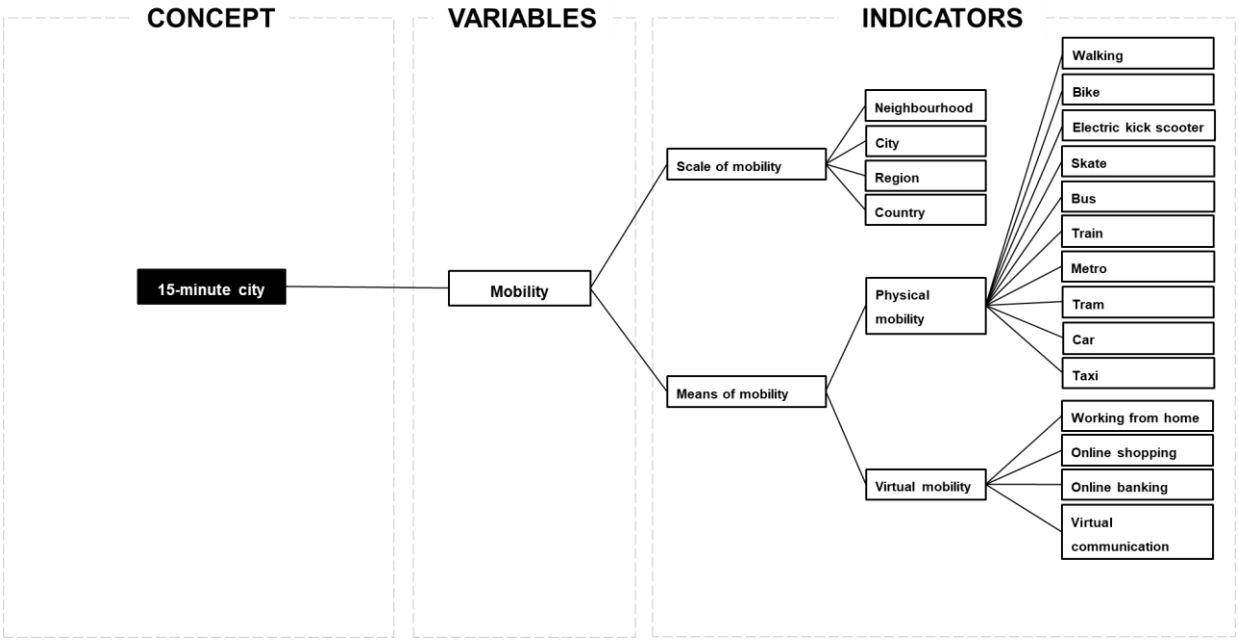


Fig. 2. Indicators of mobility

3.2.2 Time Variable

Time is widely employed as a central variable in studies assessing urban accessibility to amenities. Logan et al. compiled an overview of global cities and their adoption of time to indicate that the time aspect is different for each city all around the world. For instance, Copenhagen promotes a 5-minute access to essential amenities and public transport, while Melbourne adopts a 20-minute return trip to all amenities. Cities such as Shanghai, Paris, Milan, Madrid, and Ottawa aim for a maximum of 15 minutes by walking or cycling. Meanwhile, Portland, Hamilton, Tempe, Glasgow, and Detroit have implemented a broader 20-minute threshold [21]. These variations illustrate the difference in use of time-based accessibility goals in urban planning practice. Moreover, there is huge variety on the definition and application

of time thresholds in the reviewed literature.

Balletto et al. aim to evaluate the role of abandoned urban assets particularly large-scale buildings and compounds and their areas to facilitate the implementation of the concept of a 15-minute city, a city that is capable of granting wider social equality and access to main urban services to citizens and city users. Researchers assessed the central services reachable in 15 minutes from the main public complexes [23]. Abdelfattah et al. includes different threshold with those who are able to reach the cell in a given timeframe of 5, 10 and 15 minutes. By mapping and interpreting analyses, the resulting series of maps conceptualizes the chrono-centred mobility concept. These maps introduce an alternative chrono centric mapping approach based on population density rather than service density, revealing distributional variations at different time scales and highlighting the distinct urban character of each district. The findings illustrate how isochrones shift in shape and intensity depending on the timeframe considered. Notably, the 5-minute map reveals micro clusters of local centralities, while the 15-minute scale distinctly outlines Milan's second ring road, where the highest concentration of the resident population is situated [24]. Logan et al. introduce the x-minute city concept, encompassing travel thresholds like 5, 10, 15, and 20 minutes. While the 10 or 15-minute city has gained popularity, researchers assert that it should be avoided setting single travel time thresholds, and adopt measures that incentivize constantly improving and reducing everyone's required travel time would better support moves towards sustainable cities [21]. Staricco tested to determine the proportion of the population able to reach the selected services within 5, 10, or 15 minutes on foot in the Italian city of Turin. Within the inner part of the city, differences among census tracts are more evident at the 5-minute threshold but become more homogeneous at the 15-minute threshold. Authors conclude that different thresholds should be set in different cities and in the same city for different services. In this way, involvement of urban actors can be desirable so that essential local services can be identified and different time thresholds can be established for reaching each of them [25]. Ferrer-Ortiz et al. assigned different time threshold to each urban social function as 5, 10 or 15 minutes[27]. Noworól et al. conducted a study to examine service proximity across Kraków in Poland and assess the percentage of residents with access to specific facilities within 15 minutes walking distance. Findings indicate that both optimal and minimal 15-minute proximity zones are mainly located in Krakow's most densely populated areas. The optimal proximity zone aligns with pre-war districts planned using traditional urban design and parts of Nowa Huta, built on the concept of self-contained neighbourhoods. However, many newer housing estates fall outside even loosely defined proximity zones [28]. Liu et al. propose a 15-minute city index that integrates accessibility to five key urban functions as living, healthcare, education, entertainment, and public transit within a 15-minute active travel range. By focusing on a major Asian metropolis, Hong Kong, this study not only provides local policymakers with a quantitative tool to comprehensively assess the current state of 15-minute city development but also identifies neighbourhoods experiencing inequalities and lagging in overall accessibility to urban functions [33]. Abbiasov et al. highlight that previous research has largely focused on amenity access without investigating its connection to behaviour. Their study introduces a measure of local trip behaviour by utilizing GPS data from 40 million mobile devices in the United States, defining "15-minute usage" as the proportion of consumption-related trips occurring within a 15-minute walking distance from home [29].

Samson and Freudendal-Pedersen argue that speeding up and a lack of sensitivity to time in planning contribute to unsustainable consumption practices. The study empirically demonstrates that time is often perceived as a scarce resource in everyday activities. Since mobility frequently connects food and housing practices, the discussion primarily focuses on time perception in relation to mobility. The findings highlight the relationship between urban form, infrastructure, and the perception of limited time. Therefore, authors advocate for prioritizing time perceptions alongside urban form and infrastructure in research to support sustainable consumption [34].

Sezer et al. introduces a methodology that integrates "Transit-Oriented Development" and the 15-minute city principles from an analytical perspective, applying them to a rail station area in Palermo, a Southern Italian city facing challenges related to inefficient public transport and traffic congestion. "Transit-Oriented Development" and the 15-minute city are two urban planning concepts that have attempt to offer alternatives to the car-centred development model prevalent in modern cities. The study focuses on defining and comparing two distinct station areas based on their socio-economic, functional, and environmental characteristics, including accessibility and the built environment. Authors focused on the areas that can be covered in approximately 7 to 8 minutes by walking. The reason behind their choice relates directly to the specific context of Palermo and takes into account both spatial and behavioural factors, for instance 7-8-minute walking distance is considered as an acceptable time to access the train stations; it takes around 15 minutes to walk between consecutive nodes of the metropolitan rail line; and the 7-8 minutes distance lays roughly in the median of 15 minutes and is halfway between 5 and 10 minutes [31]. Gonyukhov & Sheludkov found out that the historic city centres are characterized by the best accessibility of facilities with the median values of 6 min. For Soviet micro districts, the values are almost 8 min for five-storey buildings. The worst accessibility is found in post-Soviet multi-storey residential buildings with almost 10 min, and in individual housing construction areas with 16.5 min, which is almost three times worse than in historical buildings [32].

It can be concluded that the time is an important variable in the field. Time can be classified as the amount of the mobility time; times of the day week, year; frequency of mobility to a certain amenity; amount of time spent in a certain amenity (Figure 3). Experience of time may differ across individuals due to factors such as age, physical ability, subjective perceptions of time, means of transportation, the spatial scale of mobility, morphology of the urban space, perception of architectural elements of the buildings in the urban space. Nevertheless, certain patterns may be observed across different social groups. Therefore, it is essential to examine the relationship between time and other key indicators to develop a more comprehensive understanding of 15-minute city.

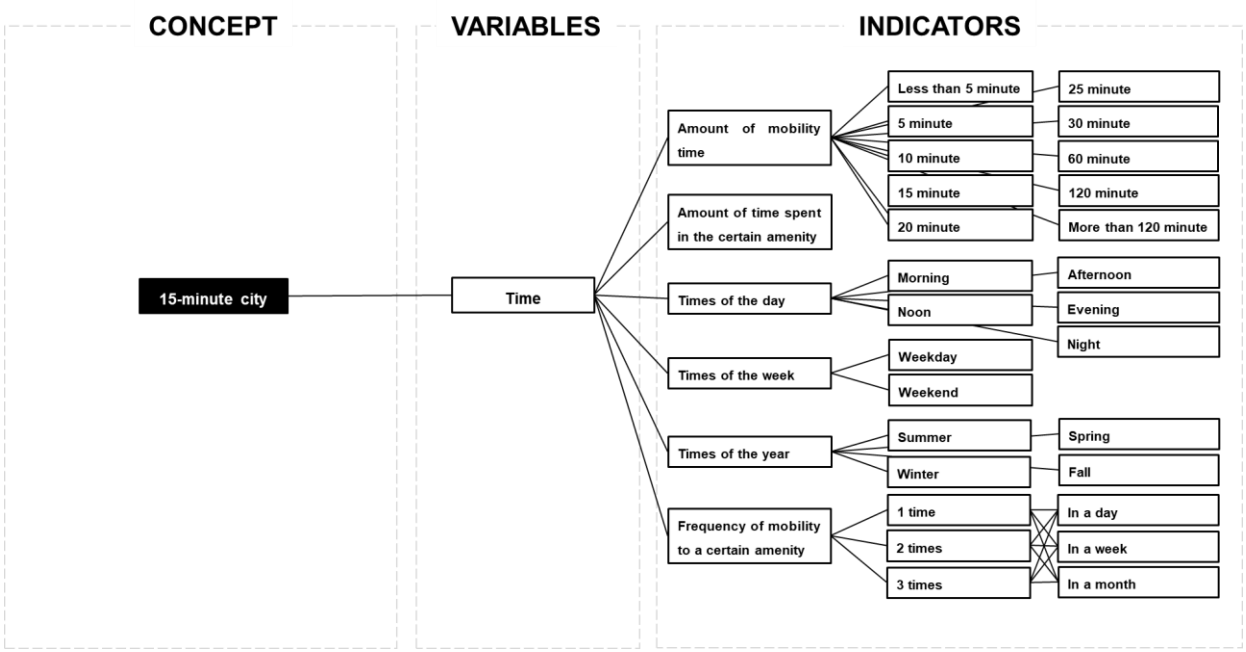


Fig. 3. Indicators of time

3.2.3. Speed and Distance Variable

Speed is a widely used indicator in many studies, particularly those employing computational tools to assess walkability as a method.

Guzman et al. using the inverse distance weighted (IDW) tool in ArcMap, isochrone curves were generated by varying walking times from household locations within the study area, assuming a walking speed of 3.16 km/h [35]. Staricco calculated the average area of the 5-, 10- and 15-minute isochrones using QGIS, with the results being 0.24, 0.95 and 2.15 square kilometres, respectively. This means that the three isochrones calculated along the street network cover 47–48% of circles with the same radius of 5, 10, or 15 minutes (i.e. 400 m, 800 m, or 1,200 m, given the average walking speed of 4.8 km/h) [25]. Ferrer-Ortiz et al. mapped the service locations as vector layers in a geographic information system (GIS) using ESRI ArcMap 10.7, and a pedestrian road graph was modelled with a travel cost assigned to a walking speed of 1.25 m/s or 4.5 km/h consistent with mobility studies [27]. Noworól et al. created a spatial database to map Points of Interest (POI), including green areas represented as polygons. The catchment areas for each service category were delineated by the distances covered by pedestrians in a straight line in 5, 10, and 15 min, respectively, assuming the average walking speed to be 1.34 m/s (or 80 m/min). Using ArcGIS buffer tools, the researchers delineated catchment areas of 400, 800, and 1200 meters around each POI, measuring access to green spaces by the distance to their borders [28]. Abbiasov et al. conduct the analysis within a 15-minute walking radius, authors extracted 15-minute walking isochrones using the Openrouteservice API. Openrouteservice is an open-source routing platform that leverages crowdsourced street network data from OpenStreetMap. Using the 'foot-walking' profile, they generated walking isochrones that specifically rely on the pedestrian street network. The platform presumes a pedestrian travel speed of 5 km h−1 [29]. Sezer et al. began the analysis with the selection of different train station exits and the assumption of a default walking speed of 5 km/h. To delineate the catchment area of the transit node, the following steps were undertaken: Defining the extent of the walking network by computing the "fastest route" through QGIS's "Network Analysis - Service Area" algorithm. OpenStreetMap's road data was used as the network, ensuring accessibility and reproducibility of the method. Conducting a preliminary validation by comparing the generated walkable network with isochrones produced by various online API services, such as Iso4App [31]. Willberg measured walking speeds in various street conditions to understand the typical variability related to season and age and based on their initial results, they modelled the walking accessibility to grocery shops in multiple scenarios. For instance, during dry road conditions, the average walking speed of adults is 5.15 km/h defined as the baseline. In respect to the older population, the average walking speed during dry conditions is 4.3 km/h [36].

It is important to acknowledge that mobility speed can vary significantly between individuals, influenced by factors such as age, physical ability, weather conditions and the chosen mode of transport. Additionally, speed may be affected by the topography and urban morphology of the environment, as well as personal experience and individual perceptual behavioural and cognitive patterns. Moreover, the purpose of the trip such as commuting to work, grocery shopping, or taking a walk may also lead to variations in walking speed.

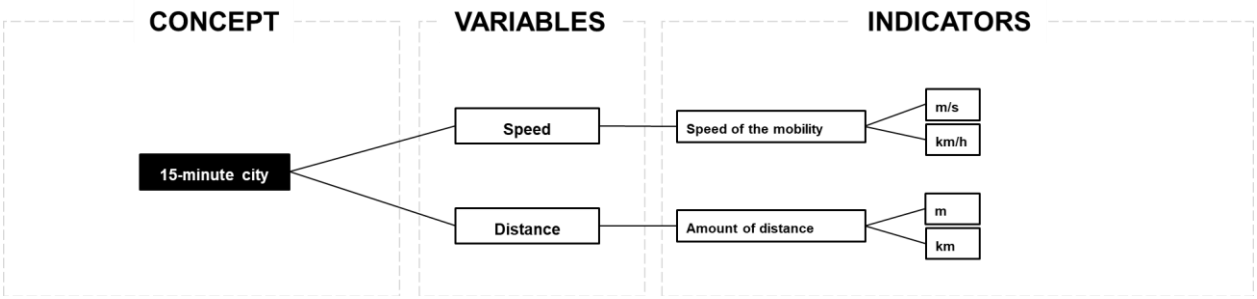


Fig. 4. Indicators of speed and distance

3.2.4. Function of the Amenity Variable

Function of the amenities is another widely used indicator in the research field and each study has identified its own set of amenities to examine.

Instead of six fundamental urban social functions proposed by Moreno et al. [6] as living, working, commerce, healthcare, education, and entertainment authors interpreted their own functions to analyse. Papadopoulos et al. presents the overall structure of the examined 15-min city evaluation initiatives, regarding the selection of urban amenities and their classification into broader categories according to their reviewed literature [37]. Logan et al. use the services and amenities of pharmacies, supermarkets, primary schools and parks [21]. Guzman et al. includes health centres (hospitals and doctor's offices), educational centres (daycares, schools, and universities), banks, local shops, and drug stores which could be reached within a maximum 15-min walking threshold from survey respondents' location (i.e., the household location)[35]. Abdelfattah et al. studied on nine service categories which are food/grocery stores, commercial stores (including clothes shops, electronics shops, etc.), cultural venues, educational facilities, parks and green spaces, restaurants, health facilities, sports facilities and other (post offices, banks, etc.) [24]. Kissfazekas examines two housing estates in Budapest, built in the 1950s under the neighbourhood unit concept, to determine which features originally considered attractive remain valuable to owners today and which are used as marketable selling points. Their findings indicate that all appealing features highlighted in the listings align with the core principles of neighbourhood units. The urban location and proximity to green spaces remain top priorities, with green areas continuing to be a key selling point for housing complexes. While access to basic services was a crucial factor in the past, its importance has diminished over time. The shift in expectations regarding shop locations is only partially linked to changes in shopping habits. Although the proximity of essential services such as schools and kindergartens is mentioned, it is not among the most significant factors. Additionally, strong public transport connections reduce the demand for parking spaces, as reflected in the advertisements, where parking is notably absent as a concern, contrasting with listings from other parts of Budapest [22]. Balletto et al. assessed central services reachable in 15 minutes from the main public complexes. They categorised the services as central places of movement (railway station, transit, port), central places of welfare (schools, parks/squares, hospitals, chemist, assistance and worship), central places of trade (food, markets, bars, restaurants, various trade) [23]. Staricco took into account twenty types of services. They belong to three main categories as education (nurseries, kindergartens, elementary schools, middle schools, secondary schools), health and social services (neighbourhood health centres, counselling centres, social care services, registry offices, post offices, police stations, churches, open-air markets), entertainment (green areas, playgrounds, playrooms, sports facilities (swimming pools, tennis courts etc.)), libraries, theatres, cinemas [25]. Vilhelmson & Elldér assessed changes in proximity to essential services in the Gothenburg city region, Sweden, over the period 1994–2014. They classify the essential services as grocery stores, pharmacy stores, primary schools, public libraries[26]. Ferrer-Ortiz et al. applied in their present study five urban social functions and the corresponding 24 variables of facilities, services, and stores and the assigned different temporal thresholds. Their categorisation is assessed as care (health, social services, day centres), education (preschool education, primary education, secondary education), provisioning (supermarkets, markets, fresh food, daily non-food, catering, miscellaneous services), entertainment (shows, libraries, civic centres, children playgrounds, sports facilities, squares and parks), public and non-motorized transport (collective rapid transport, day bus, night bus, shared bike stations, bike lanes) [27]. Noworól et al. included facilities in their study classified as education and childcare (nursery, preschool, primary school, secondary school), health care (primary healthcare centre, pharmacy, day care centre), culture (library, community centre, cultural venues: cinema, museum, concert hall, theatre, art gallery (collectively)), green areas, recreation and sports (green areas, playgrounds for children, communal sports fields for team games, indoor gym/fitness club, indoor swimming pool), shopping and services (grocery shop (any), post office, catholic church, market square, restaurant, pub/café), public transport stop access on foot within 10 min (tram) [28]. Liu et al. propose a 15-minute city index that integrates accessibility to five key urban functions as living, healthcare, education, entertainment, and public transit within a 15-minute active travel range [33]. Abbiasov et al., considered the essential amenities in their analysis as restaurants, schools, parks, health care, drugstores, arts and cultural institutions, grocery stores, services and religious organizations [29]. Sezer et al. observed that the availability and spatial distribution of city-level functions in the 'Orleans' train station area in Palermo shows that it is possible to reach many attractivity nodes classified as education (universities, high schools), military/law enforcement (police headquarters, barracks), government (offices of the Sicilian Region Presidency and the Regional Assembly), health (children's hospital) [31]. Gonyukhov & Sheludkov selected 23 types of facilities, divided into seven main categories to build the index as education (school, kindergarten, university, technical school/college), medicine (adult outpatient clinic, children's outpatient clinic, hospital, dentistry), convenience commerce (grocery chain store, pharmacy), periodic demand commerce (restaurant, coffee shop, bar, hairdresser, housewares store), recreation (cinema, shopping mall, museum, library, theatre), transport (public transport stop), green areas (park/square, pond/river) [32].

In conclusion, it is important to note that not every neighbourhood requires the same amenities within close proximity. The mobility and time indicators for each amenity should be defined based on the specific context of the neighbourhood, city or country. Moreover, the essential amenities can vary between countries, and the functions considered necessary in the past may differ from those needed today.

4. Conclusion and Future Implementation

This systematic literature review examined the operationalization of the 15-minute city concept and its potential relation to the preservation and adaptation of modern heritage areas and neighbourhoods within the broader context of historic urban landscapes (HUL). Findings demonstrate that while the 15-minute city offers a promising framework for promoting sustainable urban development, its implementation remains complex and context-dependent. Various studies have proposed diverse interpretations, indicators, and applications of the concept, highlighting key dimensions which are classified as *mobility, time, speed, distance, and the functions of urban amenities*. Despite a growing body of research analysing the differences between historic cores and peripheral settlements, significant gaps remain particularly in relation to the preservation of modern heritage areas and how these districts can be reconfigured to support walkability and liveability while maintaining heritage values.

One of the central insights of this review is that the application of the 15-minute city concept must move beyond a one-size-fits-all model. Urban morphology, mobility behaviours, amenity needs, and socio-cultural expectations differ substantially across geographies, time periods, and populations. Furthermore, post-war modernist urban fabrics which were often designed around car-centric infrastructures pose unique challenges to reconfiguration efforts, demanding a rethinking of access, function, and perception within these spaces. In contrast to historic, pre-automobile districts, these environments require more user focused approaches to realize the ambitions of proximity-based planning while maintaining their heritage values and significance.

A major area for future implementation lies in developing adaptable, scale-sensitive planning tools and indicators that consider both physical and virtual forms of mobility. Planners must consider not only the walking or biking time to essential amenities but also broader patterns of accessibility, aim of the mobility, perceived time and collective cognitive patterns of the humans which may affect the mobility.

Future research should explore the co-evolution of the 15-minute city concept and modern heritage preservation strategies through interdisciplinary methods, combining urban morphology, environmental perception-cognition-behavioural studies as well as heritage values which can be interpreted as proposed new variables and indicators categorised as *space, human, heritage.*

In conclusion, operationalizing the 15-minute city in historic urban landscapes (HUL) particularly in modern heritage areas requires moving beyond prescriptive models. It involves context-sensitive planning, space and human focused indicators, and interdisciplinary collaboration. By aligning proximity-based urban design with heritage-sensitive strategies, cities can work toward more resilient and sustainable futures aligned with Sustainable Development Goal 11 and its sub-target 11.4 on protecting cultural and natural heritage. The authors are contributing to this research by investigating and comparing case studies in Turkey and Germany.

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