15-Minute City in Urban Regeneration Perspective: Two Methodological Approaches Compared to Support Decisions

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Abstract. Among the interesting topics concerning urban regeneration, there are reconversion of disused public buildings and widespread neighbourhood facilities maintenance. The proposal of effective solutions about these topics is also a common subject for the construction of the 15-Minute City. Starting from a 15-Minute city review, a lack in the organic vision on the theme in the literature emerges, together with numerous interesting field studies, applications and experimentations in practice still to be deepened. The paper presents a comparison between different methodological approaches for the analysis of the accessibility of open spaces in order to support practitioners and policy-makers to improve walkability. The comparison between the two Italian case studies (Cagliari and Brescia) identifies the values of the systematic methodological approach based on description of context, design data collection, data analysis, indexing, to be used for co-construction of knowledge to support contemporary 15-Minute city (The paper is part of the activities of the Interdepartmental Center "Cagliari Accessibility Lab" of the University of Cagliari.).

Keywords: Urban walkability · 15-Minute city · Decision-makers support

1 Introduction

1.1 Motivations

The construction of the 15-Minute city is a subject of topicality and renewed interest for public administrations, also but not only due to the Covid-15 pandemic, as it plans to transform or live the open spaces differently. The experiences of medium and large cities that experiment plans based on the 15-Minute city principles are many, while the scientific literature, in the face of a past season of in-depth study on walkability, pedestrianism and proximity, does not yet seem to systematically address the theme (see Literature review). Among the emerging themes in urban regeneration [1–3], understood as the transformation of building fabrics, services, open spaces, but also of social relations, in contexts that tend to contain land consumption, can certainly be included:

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- The recovery of large abandoned buildings;
- The maintenance of small residential fabrics (also to be redeveloped) and the network of services connected to them.

The redevelopment of public real estate assets has long been at the center of research attention, both for historical-architectural stylistic aspects and for spatial-urban ones: services - cultural, health, ecosystem services, [4, 5] - and mobility - walkability, cycling, e-mobility [6]. However, this is a difficult task, also due to the economic crisis, which together with the health crisis do not facilitate, on the one hand, the federalism of this asset [7], and on the other its related requalification, although considered fundamental for improving urban, social and environmental quality [8, 9].

In this synthetic framework, the planning of proximity services, which is inspired by small municipalities, is capable of determining high levels of livability that guarantee a balanced relationship between services and communities, greater sustainability of mobility and generate-consolidate a network of community relations [10]. The transposition of the proximity services of the small town in the medium-large city can be represented through the 15-Minute city [11]. However, in the medium-large sized cities the proximity services are often "hosted" by obsolete buildings and infrastructures that need to be renovated or regenerated according to energy, safety and environmental aspects.

Furthermore, the lack of a structured 15-Minute vision on the city in the academic field, or updated to the modern context, as shown by the literature analysis, and the themes of interest for urban regeneration have led to propose in the present paper a comparison between methodological approaches for the analysis of the accessibility/walkability of open spaces to support decision-makers to identify the most effective and significant characteristics that could become the strengths for design the 15-Minute city. Two case studies were then selected to compare the methods used in the field of disused public building (in Cagliari) and residential urban fabrics and related services (in Brescia). The two identified themes are intentionally different from each other, in order to highlight more considerations. We characterize these works along a continuum ranging from communicative planning to planning technologist" [12] his paper proposes two techniques GIS-based to visualize and locate problems supporting the decisions of policy-makers [13, 14]. GIS is also used as Geospatial/Geovisual Decision Support Systems [12].

Aim of this paper is addressing the issue related to the 15-Minute city, analysing it from the literature review point of view, and also proposing two different methods of analysis, applied to two different cities in Italy (Brescia and Cagliari). In particular, the idea was that of selecting some particular neighbourhood in the two areas, observing the availability - or lack - of services according to two different approaches: Space Syntax in the case of Brescia, and the development of suited-for-purpose basic indices of porosity (PI), crossing (CI) and attractiveness (AI), and combined index Walkability through Big Building (WBBI) of urban 'enclave' in the case of Cagliari. In the present case, the two areas were analysed following two different approaches, while the idea developed throughout the realization of the present research, for future activities, will be that of combining the two methods applying them all to different case studies.

The rest of the paper is organized as follows. A literature review is carried on in Sect. 1.2. Section 2 addresses a comparison of methodological approaches. It contains a description of the different methods adopted and the two study areas, together with a

discussion and comparison of the areas, methods and results obtained. Section 3 on final considerations concludes the paper.

1.2 Literature Review

Cities are complex organisms that live thanks to substructures that are not always in an organic relationship with each other. The evidence is often that of apparently uncontrolled growth and conditioned by the income from infrastructural investments, rather than by the quality of life. On more than one occasion, the positivity of urban schemes that are based on accessibility to services or stops of Local Public Transport has been recognized. As a matter of example, the case of Stockholm, which won the EU green capital award for this reason: still, the case of Freiburg which based integrated urban planning and transport on these principles. In small urban areas, access to essential services should take place within a period suitable for non-motorized travel (hence the idea of "15-Minute cities"), while in larger urban areas that should be the maximum time for access to a transport system that connects the city.

In the face of the wide and consolidated academic and technical literature relating to Transit-Oriented Development (TOD), even if limited to urban studies (e.g. [15–28]), the well-known importance of a strong public transport system is for structuring more sustainable cities from the point of view of mobility [29–35]. We want to investigate the system of services and relationships between the different urban functions that revolve around the concept of proximity. Some pushes on this approach starting from the TOD are present in Chatman, Ratner & Goetz, Boarnet & Compin and Freilich [36–39] and the so-called "15-Minute City". The scientific literature that clearly deals with 15-Minute City using this term properly is practically nil (Web of Science, Scopus, Franco Angeli, etc.). On the other hand, there are many references of an experimental nature and best practices applied at the planning level which are included in reports evaluating the performance of the cities [40]: for example, Edinburgh, Utrecht and Ottawa; Melbourne had an urban plan called "twenty-minutes neighbourhood", while in Copenhagen the new zero-emission district of Nordhavnen is nicknamed "five minutes to everything" and Paris started the Plan "Ville du quart d'heure". The studies that analyse the area that can be reached in 15 min on foot can represent an indirect reference to the concept, but they are mainly specialized, not generalist and systematic studies. The case studies that analyze a specific phenomenon aim to find technical solutions for accessibility and its development opportunities [6, 41–43]. It can be deduced that the topic is of interest to society and little dealt with systematically from the academic perspectives, so the topic is original.

Furthermore, to frame the topic in general terms, it is appropriate to consider some references that, by extension, concern the same approach with different taxonomy, such as the concept of "proximity" in the city or "soft city". The literature in this sense is very rich [28, 44–58], but less known by practitioners and little applied at an operational level in the last century.

2 Comparison of Methodological Approaches to Walkability

2.1 Analysis and Comparison

In this paragraph, the selected case studies are compared. The two case studies are different and complementary in the typical Italian cities. So a case study (in the city of Cagliari) deals with the issue of largely dismissed buildings, while the second case (in the city of Brescia) concerns the relation between (vulnerable) city-users and services in a residential context.

The elements compared in the analysis are: topic (problem to solve), subject (area investigated in the case study), preliminary information/knowledge (planning tool or data at the base of the case study), methodological approach (the method used in the study). The comparison after the analysis allows to identify the strengths and weaknesses of both approaches and it will allow clarifying which methodological aspects can be more significant for the 15-Minute city and urban redevelopment in general terms.

2.2 Methodology of the Case Study of Cagliari

The Cagliari case study (558,684 inhabitants in 2019, in the case of the Metropolitan City, Region of Sardinia) refers to the historic center of the main municipality divided into four districts, within which there are urban enclaves resulting from the abandonment of big buildings.

The proposed method, extrapolated from a previous research always tested on the city of Cagliari [6] is based on the elaboration of a series of indices, considered useful and interesting to evaluate the capacity of disused public buildings to act as potential public spaces. This constitutes one of the main challenges for the city of Cagliari and for contemporary cities in general. Therefore, indicators have been developed to support walkability in contexts characterized by urban enclaves.

In particular, with three basic main indices of porosity (PI), crossing (CI) and attractiveness (AI), and the combined index of Walkability through Big Building (WBBI), they are functional to the reduction of the above-said urban enclave effect. In particular, Porosity Index (PI) is the weighted coverage ratio, between the building area and the pertinent free land area; Crossing index (CI) represents the level of crossability that characterizes each public property and that allows people to reach different parts of the city. This index, in fact, depends on the architectural morphology of the building, in particular on the number of crossings and paths that connect the various entrances to the property; The attractiveness index (AI) refers to both the number and variety of central locations located in the area that can be walked in 15 min from the enclave.

Therefore, for the calculation of this index, the Simpson diversity index was taken as a reference, which allows us to give weight to the diversity of urban boundary functions. The Simpson index is applied to represent ecological diversity, but is also applied by analogy in the urban context [6, 59], that is to describe the diversity of urban services. The proposed methodology is applied in the focus of disused public buildings of the Strategic Plan of the metropolitan city of Cagliari (2020).



Fig. 1. City of Cagliari, - Sardinia - main enclaves deriving from disused public buildings (001, 002, 003 B_ing).

The method required:

1. the assessment of the strategies the urban plan of the historic center;
2. the assessment of the urban context, urban morphology and the community for the definition of service groups (movement, welfare and trade);
3. use of the OSMR1 algorithms referring to Google maps for the determination of the isochrones.

After evaluating the strategies of the urban plan of the historic center, public works plan of the Municipality of Cagliari and carrying out a number of inspections both in the abandoned buildings and in the immediate context, the quantitative evaluation of the services was carried out.

The first analyzes concerned the equipment and pedestrian accessibility of the proximity services of the selected enclaves (001, 002, 003 B ing) through a qualitative assessment of the walkability deriving from digital traces, (strava.com) and the quantity of services divided by categories (google maps).

Once the data was collected and georeferenced, it was possible to evaluate the indices: porosity (PI), crossing (CI) and attractiveness (AI) and Walkability Big Building (WBBI) of each disused public building area (Fig. 1). Though these indicators were contextualized by specific context weights, it is intended to measure the intrinsic and extrinsic characteristics of disused public building areas, in particular of large dimensions and extensions. The proposed approach allows us to represent the quality of the public space and therefore its potential in the city of 15 min. In particular, these indexes make it possible to relate intrinsic elements (PI and CI) with extrinsic elements (AI) of a given decommissioned real estate asset with big-sized dimensional characteristics. This is in order to act in the redevelopment of abandoned assets to obtain maximum walkability, knowing that the ideal reference benchmark is given by squares and urban parks. In fact, PI, CI = 1 and AI = 1 (WBBI = 100) occur in an open space, which can be crossed

in several directions and with a relative diversified attractiveness. In doing so, WBBI can support decisions in order to evaluate the intervention priorities aimed at making urban contexts, today characterized as enclaves from abandoned public buildings. In particular, we have intended to evaluate the possibilities of making the "central places" of the past, such as ancient factories, hospitals etc., accessible in pedestrian terms in a logical and flexible network, where the "walkability" can renew the quality of life.

2.3 Methodology of the Case Study of Brescia

The case study of Brescia (196,134 inhabitants in 2019, Lombardy Region) concerns a specific district of the city: an economic-popular housing neighborhood with clearly identifiable and rather homogeneous typological characteristics, attributable to the experience of Father Marcolini, called "Villaggio Prealpino" (4,417 inhabitants). It is located in the North of the capital city on the territory of two municipalities (Brescia and Bovezzo) and built by the Cooperative "La Famiglia" between 1958 and 1972.

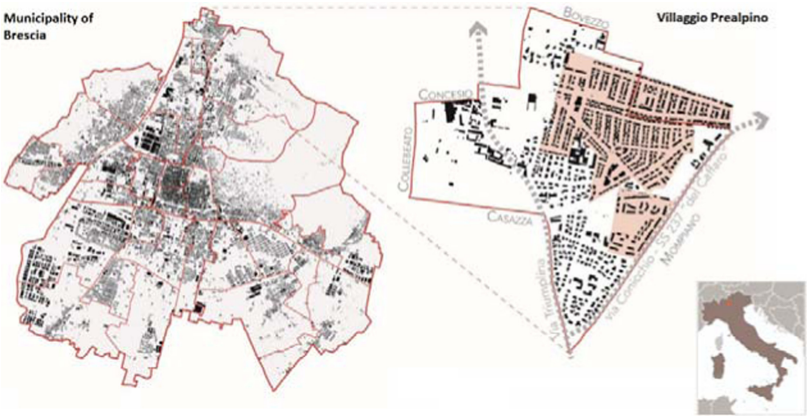

Fig. 2. "Villaggio Prelpino" Neighborhood in the City of Brescia (IT)

The methodology proposed in this case study carried out in 2019 is strongly civitas-oriented (focus on the civitas, the "city of people" and the city of the urban life, not on the urbs, the "city of stone", the built one [60, 61]): it places people and his relationships at the centre [62]. The analysis uses GIS software (QGIS). The alphanumeric data at the beginning processing phase needed to be georeferenced and therefore become usable for subsequent processing with QGIS. The method required the following steps:

- Analysis of demographic factors and urban load georeferentiation;
- Organization of existing services into categories and georeferentiation;
- Cartographic definition of the pedestrian mobility network;
- Proximity analysis through the GIS Space syntax plugin;
- Identification of the imbalance in the supply-demand ratio by type of service in the study area.

The analysis of demographic factors focused on the resident population by sex and age group and in particular on the elderly population (over 65 years old). Once the data had been collected and geo-referenced, it was possible to create the board in Fig. 3 which shows the urban load for each building and to evaluate the presence of buildings with an elderly population only.

The analysis of public services present in the Villaggio Prealpino was developed based on the Municipal urban plan which reports, in the Service Plan ("Piano dei Servizi"), the provision of existing public services. This information was implemented by additional open-source data (Google Maps, White Pages website, specific websites for commercial activities) and by site inspections. In the analysis, health and social assistance services were privileged (clinics, clinics also in the third sector), parks and gardens, religious and cultural services (including the library), childcare services and schools and a selection of administrative services to identify the spaces and services essential for the daily life (and health) of the elderly. Besides, small neighborhood shops were included in the analysis, considered essential to encourage pedestrian mobility. Information was collected on nearly 50 services. An example regarding the collection and mapping of the green area is shown in Fig. 3.



Fig. 3. Urban load per building with a particular focus on the elderly, on the left, and a sample of services analysis about green areas, on the right.

Once the places of the departure and potential arrival of the population were defined, we proceeded with the design of the pedestrian network to know the potential flows. The *Space Syntax*[1] tool was used to carry out this analysis. It is based on a set of techniques for analysing spaces (be they buildings or urban areas) and the human activity that takes place in them. The theories holding this methodology were put forward around the Seventies by Hillier and Hanson [63], and then it was implemented until the creation of software, usable in QGIS (see also [64]). At the basis of this system is the awareness of the close link between society and the environment in which it operates and lives. Space is an intrinsic sign of human activity itself, and what happens in a limited area can be strictly influenced by the relationship between that single space and the network of spaces with which it is connected.

Space Syntax enables you to analyse the relationship between spatial elements (points, segments, areas, etc.) starting from their configuration, in various ways. The result is a spatial model from which it is possible to carry considerations regarding urban mobility (but also other phenomena) through a process that starts from the analysis and, in some cases, also permits us to forecast future dynamics and behaviours[2], albeit with limits [65].

The plugin made it possible to view the range of influence of some services based on the present paths (consisting of the pedestrian mobility network), overcoming the concept of approximate "radius" traditionally represented by a circle. In fact, the "Catchment analyser" function of Space Syntax allows calculating the distance travelled on the pedestrian network (Network layer) starting from the chosen service (Origin layer). The first step to perform this operation is the validation of the Network layer: all errors (indicated in a specific window) must be corrected. The operation can be quite laborious and require the partial or total re-tracing of the network through specific criteria. After validation, in the "Catchment Analyzer" window it is possible to specify the chosen shapefiles and the desired distances for a chromatic representation scale (in this case 0, 150, 300, 400 and 500 m). The starting layers and the result of the processing were then loaded into a special folder using the *QPackage plugin* and imported into the general project file (within QGIS 3.4.6)[3]. The outcome of the processing for example for medical clinics is shown in Fig. 4.

[1] The plugin is called Space Syntax Toolkit. It is available at: https://spacesyntax.net/software/.

[2] Space Syntax website https://www.spacesyntax.org/.

[3] Space Syntax Toolkit is not compatible with the latest versions of QGIS, therefore all processing related to spatial analysis was performed in the version 2.18.17.

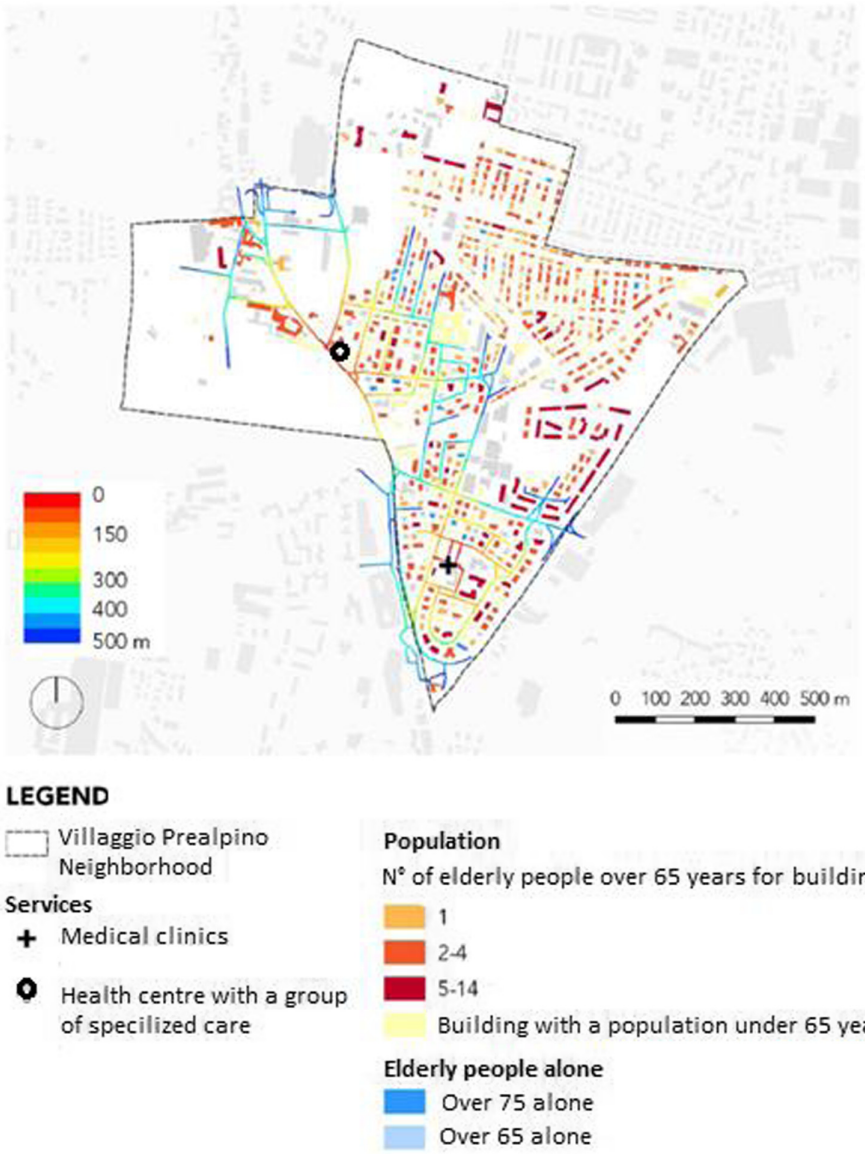

Fig. 4. Mapping via *space syntax tool* of the distance of services from users

2.4 Highlights from the Two Methodological Approaches

The comparison between the two methods has the purpose of highlighting any point of contact and/or elements that could allow an improvement for both, also through the identification of the relative strengths and weaknesses.

The explanatory table of the comparison between the two case studies for the elements identified in Sect. 2.1 is shown below.

	Cagliari	Brescia
Topic	Accessibility potential of large abandoned public spaces	Accessibility to existing services by residents (vulnerable users - the elderly)
Subject	Abandoned public space with a relative area of relevance ("service area")	Neighbourhood (Marcolini village)
Preliminary information/knowledge	Metropolitan Strategic Plan, Urban plan of the historic center; Cagliari public works plan	Service Plan and its update (offer of service)
Methodological approach	1. Service area identification for each site 2. Analysis and organization in categories of existing services 3. Analysis of the basic data for the construction of the indices and assignment of the weights 4. Calculation of indices (Porosity, Crossing i, Attractivity) 5. Calculation of the composite index (Walkable Big Building Index) 6. Comparison between sites 7. Ranking and identification of weaknesses of each site	1. Analysis of demographic factors and georeferencing of the urban load 2. Organization in categories of existing services and georeferencing 3. Cartographic definition of the pedestrian mobility network 4. Proximity analysis - Space syntax 5. Identification of the imbalance in the supply-demand ratio by type of service in the neighbourhood

2.4.1 Strengths and Weaknesses

Among the strengths of the method proposed in the Brescia case study is the immediate understanding of the outcome of the analysis. The chromed scale that highlights accessibility to the service is simple and easy to read. The size of the influence range can be easily changed to produce different scenarios. The weaknesses of the method concern the difficulties of acquiring the initial data, data processing requires specific software and specialized knowledge. A public administration does not always have the availability of these resources and therefore such decision support can only be provided by an external body.

On the other side, the strengths of the method proposed in the Cagliari case study is the immediate understanding of the results of the evaluations, simple and easy to read. The proposed indices allow to represent the context and support decisions. The weak points of the method concern the difficulties of geo-spatial representation of context data,

which require a thorough knowledge of Geographic Information System and Google Maps, Google earth, Google Earth studio applications.

3 Final Consideration

These methods are useful for viewing problems and proposing scenarios, but the use of the methodology is only one of the steps in a decision process that must involve citizens. After carrying out the analysis (from a theoretical point of view), a confrontation is required both with the decision-makers and with the population living in the neighbourhood. Effective design, even for the 15-Minute city, must necessarily be set on a community-based approach (Community-Based Research e.g. [66]).

The walkability of a place becomes an indicator of the social and economic status of its community [67, 68], playing a role in: accessibility to services and inclusiveness and social equity. Furthermore, in the 15-Minute city, the interactions-relationships that can be generated by pedestrian movements in strengthening the sense of community consolidate the 'common goods' of public space and health and well-being.

In fact, the methods used, although different from each other, also to better adapt to the context, are based on these principles, obtaining as out-put maps for the case of Brescia and indices for the case of Cagliari. In this sense, the next step will be to combine the two methods in both cases to evaluate how their combined action is.

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