Sustainable Urban Mobility Planning and Walkability in the Post Pandemic era. Assessing the Role of Urban Enclaves

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Abstract. The process of economic, social, and cultural development leads to relevant changes in urban areas. Urban transformations usually generate a series of public and private real estate compounds which constitute real obstacles to urban walkability. The growing attention towards the sustainable development goals established on a global scale introduced new contents in urban redevelopment policies, aimed at favoring higher levels of accessibility in the consolidated fabric, particularly that of the pedestrian type. In addition, the recent pandemic has recently reassessed the role of pedestrian mobility as a primary way of moving instead of using other means of transport. As a result, urban walkability has moved at the core of the sustainable city paradigm. More precisely, issues related to accessibility and walkability should be considered when addressing the obstacle generated by those sites that can be properly defined 'urban enclaves', especially when abandoned or under redevelopment. These conditions may encourage the gradual reopening of these areas for citizens. Within this framework, the Sustainable Urban Mobility Plan (SUMP) can represent a strategic tool for identifying the critical aspects to face for the creation of a new network of pedestrian routes aimed at improving urban walkability. The objective of this study is to define a set of principles and criteria, both tangible and intangible, for calculating the proximity index (PI). The PI may consequently drive urban regeneration projects also through the design of new paths for crossing the enclaves to improve urban permeability and, therefore, the level of walkability (This paper is the result of the joint work of the authors. In particular: Sect. 1 and 3 have been written by M. Ladu; Sect. 2 by F. Camerin; Sect. 4 and 5 by G. Balletto and M. Ladu.).

Keywords: Sustainable mobility · Walkability · Urban enclaves

1 Introduction

The current health crisis has made even more evident specific problems affecting contemporary urban areas. Various levels of government have addressed them to promote

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sustainable development models. Environmental crisis and, more precisely, atmospheric pollution, stands out because it influences the health condition of people [1, 2], so it requires new urban planning paradigms based on the theories of the 15 min City [3] and the Proximity and Health City [4]. These solutions, in turn, bring the challenges related to walkability and accessibility back to the center of the recent urban debate.

Mobility plays a fundamental role in this context as it is the result of a complex phenomenon of economic and social interaction between various territorial-scaled activities and the transport system, which responds to a derived need. The latter is generated by the physical form and the organizational and functional structure of the territory.

Within this framework, if mobility represents the potential ability to travel, accessibility is the measure of this attitude and represents an interaction between people, goods and activities located in different places. Accessibility has historically been defined as the degree of ease with which an individual can reach a spatially distant place using a specific transport system [5]. It means that accessibility depends on four main factors:

– characteristics of the individual;
– distribution of activities on the territory;
– place of departure and arrival; and
– transport system that connects a specific area to the other located in the territory.

Until the 1990s, accessibility was linked to a dual concept that led to the recognition of the transport system as the main response to the demand for local mobility. From the 1990s, web technology and, in general, ICT systems, have led to major changes in the ways of relating and using activities located in the territories, transforming the consolidated dual paradigm (spatial proximity-physical mobility) into a tripolar system (spatial proximity-physical mobility-digital connection) [6]. The pandemic has then increased the value of digital connection systems in guaranteeing adequate accessibility to primary services and more. At the same time, the need to ensure inclusive, safe, healthy, and sustainable cities has brought attention back to open spaces and sustainable urban mobility, including slow and pedestrian mobility. The health crisis has indeed highlighted the need of individuals to move on foot to reach the main urban facilities

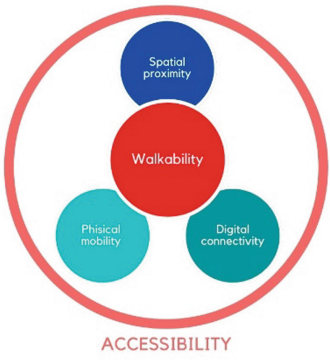

Fig. 1. The walkability as a transversal element of the tripolar system of accessibility (spatial proximity- physical mobility-digital connection). Author: Ladu M. (2022).

[7], making pedestrian mobility a transversal element of the tripolar system (spatial proximity-physical mobility-digital connection) (see Fig. 1).

Within this framework, the Urban Sustainable Mobility Plan (SUMP) may represent a stimulating planning tool for achieving the Proximity City, guaranteeing higher levels of pedestrian accessibility and, therefore, quality of urban life. The promotion of urban walkability, to achieve also by expanding bike and pedestrian paths to reduce vehicular traffic, contributes not only to decrease air pollution levels but also to responding to the need for healthier lifestyles. Despite this growing awareness, a significant obstacle to the realization of the urban walkability project is represented by the public or private real estate sites often unused [8]. Due to their size and architectural features, these areas represent impenetrable places, a sort of real enclave in the urban fabric.

Starting from these assumptions and the analysis of the potential role that the Urban Sustainable Mobility Plan (SUMP) plays to face the new challenges of the sustainable city in Italy, this paper proposes a methodology for calculating an index aimed at measuring the degree of transformability of urban enclaves. It is believed that the attribution of the degree of transformability can prove to be functional to the definition of urban planning strategies aimed at improving and increasing the existing pedestrian network.

After the first section (Introduction), the rest of the paper is organized as follows: second section: Literature review, dedicated to an in-depth study of the concept of urban enclaves, especially in reference to the case of the military settlements (Sects. 2); third section: Materials, wherethe opportunities of the Sustainable urban mobility plan and the most relevant aspects of a recent planning experience in Italy are discussed (Sects. 3); fourth section: Method, which focuses on a methodological proposal to improve urban walkability through the Proximity Index (PI) (Sects. 4); Results and Conclusions are drawn in the fifth section, where the main research results carried out are presented, together with the future developments of the study (Sects. 5).

2 Urban Enclaves. The Case of the Military Settlements

Enclave is a term derived from the French eclaver, i.e. “to close with a key”, and from the vulgar Latin inclavare, “to lock up”. It defines closed and sheltered spaces that can be possibly opened with an entrance from the outside to the inside and vice versa. Due to their condition and position, enclaves maintain a close relationship with their surrounding context. The notion of enclave, which is significantly reviewed by Aiello [9], is often applied to research on gated communities. In this field of study, enclaves are pretty much defined by the presence of “gates, walls, and guards” [10]. From a spatial planning point of view, this definition can be quite literally applied to a specific kind of enclave in urban environments, i.e. military settlements, which are large land-consuming spaces immured. Their relevant presence in the Italian cities relied on the need to provide accommodation and training areas for soldiers since the Italian Unification. The realization of these settlements followed specific architectural and urban schemes according to an international debate among military engineers [11]. The condition of enclosures was also characterized by their location at the border of the 19th-century Italian city centers and their condition of a large piece of land excluded from the real estate dynamics. These factors have strongly contributed to making them drivers of

urbanization patterns over decades. As a matter of fact, urban historians [12, 13] claimed that quartering usually overcame planning rationales due to national security needs and provided ad hoc enclosures that have been both physical and conceptual barriers that separate the military from civil society. It is in this sense that military settlements cannot be considered only topographical locations in the city, but the military interacts with the local population, even though the latter is usually forbidden to enter the military enclosure.

The end of the Cold War and the dissolution of the Soviet Union in 1991 was a pivotal event that implied strong geopolitical changes and territorial repercussions such as the Forced Army's reorganization and rationalization. As a result, thousands of military settlements have faced closure since the 1990s [14]. The conversion of former defense sites became a significant challenge in terms of urban regeneration that took decades to complete due to a variety of factors [15]. In particular, once abandoned, military enclosures may lose their meaning as immured spaces for fostering new mobility patterns. Behind the perimetral wall, the morphology of military sites is made up of precise layouts. Wide-open and green areas for circulation and training give military enclosures the potential value for developing new urban mobility planning schemes on the basis of slow-mobility routes. This, in turn, may improve urban permeability and thus the level of walkability. The same opportunities may be tied to other public-owned sites that, like military sites, show similar architectural and urban planning schemes that give them the status of proper "urban enclaves" (see Fig. 2 and 3).

Fig. 2. Abandoned "Tommaso Salsa" barracks as urban enclave, Treviso (IT). Source: photo by F. Camerin.

Fig. 3. Abandoned "Tommaso Salsa" barracks as urban enclave, Treviso (IT). The perimeter wall of the military site. Source: photo by F. Camerin.

The focus of this study is precisely on the appropriateness of the regeneration of such sites with the aim of providing useful tools to guide the proximity city project.

3 The Opportunities of the Sustainable Urban Mobility Plan

In Italy, the Sustainable Urban Mobility Plan (SUMP) is a strategic planning tool based on the principles of integration, participation, monitoring, and evaluation drafted to meet the demand of mobility for people and goods. The SUMP aims to ensure the right to mobility, without burdening, as far as possible, in terms of air and noise pollution, traffic and road accidents. It is a tool that contributes significantly to improving the quality of life and the environmental performance of urban areas in order to ensure a healthier urban system within an overall framework of sustainable economic and social development. In contemporary times, characterized by a return to the principles of the Walkable City, the SUMP can represent a strategic planning tool to support the realization of new scenarios of walkability.

The case of Modena stands out within recent experiences of sustainable urban mobility planning (see Fig. 4). Here was made an attempt to ensure the integration of the two forms of active urban mobility, i.e. walking and cycling. More precisely, the creation of a new network of pedestrian paths was highly integrated with the cycle paths' one. Another relevant aspect of this experience concerns the ability to recognize the strong interactions between mobility systems and urban development issues. The SUMP [16] was developed in full synergy with the local development plan (LDP) of the Municipality of Modena. This approach is at the base of the sustainable urban planning that tends to manage the demand for mobility, coordinate development policies, contain land consumption, and pursue urban quality.

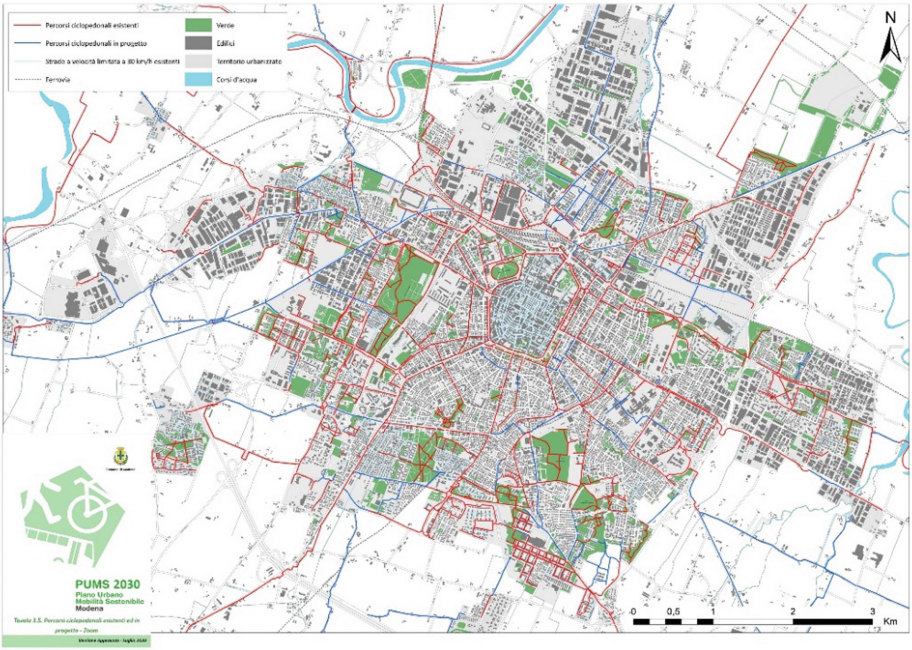

Fig. 4. Existing and planned pedestrian and cycle paths, SUMP, City of Modena (July, 2020). Source: https://www.comune.modena.it/servizi/mobilita-e-trasporti/pums/documenti-pums

Considering the obstacles generated by the urban enclaves in the development of a Walkable City, the authors argue that the SUMP should become a strategic tool to highlight and address these critical issues, especially regarding the positive externalities that the opening of pedestrian and/or cycle paths could generate in the urban environment. These types of interventions affect urban morphologies so may contribute to transform immured sites into opportunities for mobility [17]. The creation of new networks of pedestrian and/or cycle paths ensures higher levels of urban walkability, as well as proximity to urban facilities, in line with the 15-min city paradigm [18, 19].

4 A Methodological Proposal to Improve Urban Walkability: The Proximity Index (PI)

The need to guide design choices aimed at creating new pedestrian paths within the city led the authors to develop a methodology for calculating the proximity index [20]. It required the definition of a series of indicators to evaluate the positive externalities generated by the opening of a pedestrian and cycle path within an enclave.

The method used is based on the Deming Cycle framework [21] which allows a continuous monitoring process and result.

In particular, the method is divided into the following phases (see Fig. 5): i) Plan: phenomenon observation (survey and analysis of urban enclaves) and goal definition;

ii) Do: desk analysis and dataset evaluation to define a set of indicators and index construction (PI); iii) Check: comparison of the results (values of the PI associated with each enclave) and intervention priority assessment; iv) Act: promotion of urban regeneration policies (definition of a time schedule of interventions according to the priorities identified by the PI).

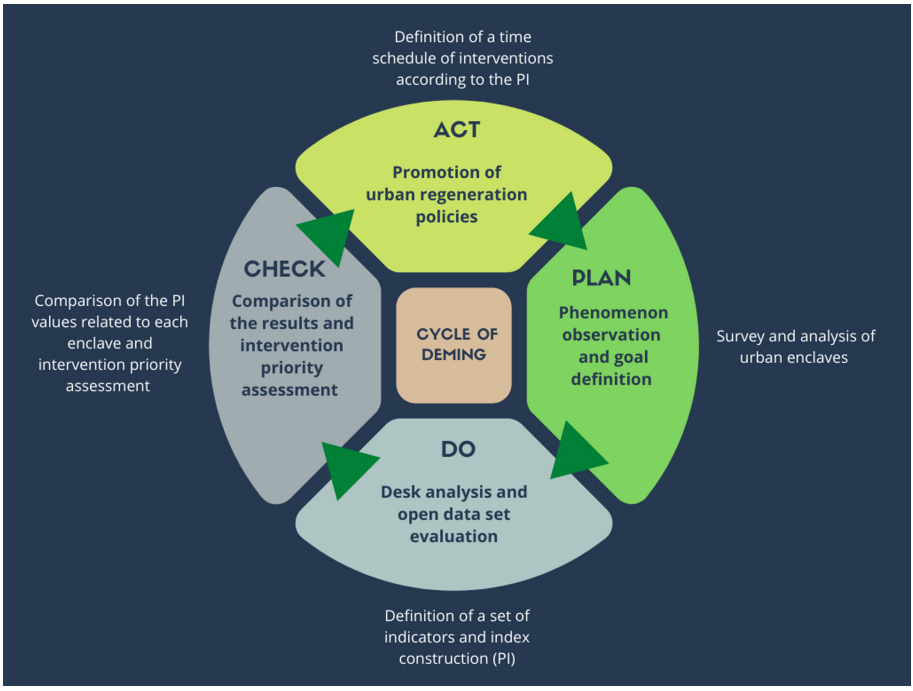

Fig. 5. Methodological framework based on the Deming Cycle. Authors: Balletto G., Ladu M. (2022).

The five indicators we are proposing are fundamental to represent the characteristics of a single building or public real estate complex (intrinsic characteristics), and those of its context (extrinsic characteristics):

1) Attractiveness indicator (A): this is given by the product between the number of functions located in the context and the weight (w_a) from 1 to 10, which increases as the variety of functions increases;
2) Uniqueness indicator (Un): this is given by the product between the number of potentially feasible crossings in the enclave and the weight (w_{un}) from 1 to 10, which reaches the maximum value if there are no alternative crossings in the immediate vicinity and there is no possibility of make new ones;
3) Usability indicator (Us): this is defined as the degree of difficulty in walking the crossing, determined by the physical characteristics of the space to be crossed,

whether it is open or closed. It assumes a value between 1 and 10 (w_{us}), where 1 represents the maximum degree of difficulty and 10 the minimum degree of difficulty.

4) Satisfaction indicator (S): this is given by the product between the number of inhabitants who would benefit from the opening of the crossing in the neighborhood and the weight (w_s) from 1 to 10;
5) Feasibility indicator (F): this is defined as the degree of technical and economic difficulty in making the crossing. It assumes a value between 1 and 10, where 1 represents the maximum degree of difficulty and 10 the minimum degree of difficulty (w_f).

The Proximity Index (PI) is given by the sum of these indicators, according to the following formula:

$$PI = \sum_{i=5}^{n} Ii/50 \tag{1}$$

where: $I_i = A, Un, Us, S, F$ *for* $i = 1, 2,3,..5$ *and, consequently,* $0 \leq PI \leq 1$.

5 Results and Conclusions

The analysis of the indicators of attractiveness (A), uniqueness (Un), usability (Us), satisfaction (S), and feasibility (F), appropriately weighted, and the subsequent calculation of the Proximity Index (PI), provide an assessment of the degree of transformability of the urban enclaves in relation to the possibility of creating a network of pedestrian paths. More precisely, after selecting sites having the characteristics of "urban enclaves"', the PI assigns a different degree of priority of intervention to each of these parts of the city. It defines a hierarchy in terms of positive externalities that can be generated by the progressive opening of the immured sites for the construction of pedestrian and / or cycle paths. In this sense, the PI represents a useful tool to support the decision-making process in the implementation of urban regeneration projects aimed at pursuing the model of Proximity City.

Moreover, this index may stimulate the introduction of temporary and/or transitory interventions in urban governance. As a matter of fact, the indicator referring to the feasibility informs about the possibility of creating new pedestrian crossings in certain urban enclaves, even before defining an overall redevelopment scheme for the entire site. It is believed that such transitory interventions, aimed at promoting urban walkability, can increase the attractiveness of the property, give it a new identity, and facilitate the choice of new uses.

The present study recognizes the role of the SUMP as a strategic tool to integrate the issues concerning the regeneration of urban enclaves within the more complex framework of objectives to achieve through the sustainable urban mobility planning. In line with this renewed perspective, the SUMP could indicate the most critical enclaves and the related proximity indexes to guide the realization of a new network of pedestrian paths, in line with the provision of the local development plan.

The next steps of this study can be the following: choosing an urban setting for the application of the proposed methodology; tests on urban enclaves, also taking into

consideration the scenarios proposed by the planning tools in force, as the local plan and the Metropolitan Strategic Plan [22]; and defining a time schedule of interventions according to the priorities identified by the PI and the offer of local public transport (LPT).

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