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Living and Walking in Cities

New challenges for sustainable urban mobility

This Special Issue intended to wonder about the new challenges for sustainable urban mobility, aligning with the European Sustainable & Smart Mobility Strategy. Contributions come from selected papers of the XXVI International Conference "Living and Walking in Cities" and have been collected around two main topics: the relationship between transport systems and pedestrian mobility and the transformative potential of temporary urban changes. Reflections and suggestions elaborated underline a collective great leap forward to reshaping urban mobility paradigms.

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Living and walking in cities: new challenges for sustainable urban mobility

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Assessing mobility in sustainable urban regeneration. The GBC Quartieri application to Le Albere neighbourhood in Trento

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Abstract
In order to minimise the negative impacts of new districts, mobility analysis plays a crucial role. Indeed, urban expansion may lead to increased car use to access basic services. Establishing interconnections between novel localities, parking spaces, public transportation routes, limiting the heat island phenomenon and instituting renewable energy sources are indispensable for realising sustainable design. This approach may mitigate the adverse impacts of informal urban expansion and foster condensed, pedestrian-oriented neighbourhoods that encourage cycling and walking. In this context, international protocols can provide valuable guidance during the planning and upkeep phases by furnishing analysis and design recommendations. In this paper, starting with an analysis of the GBC Quartieri energy and environmental sustainability protocol on an urban scale, a method for evaluating the protocol's responses to known mobility-related critical issues was prepared and used to evaluate the case study Trento Le Albere project. This showed that almost 50 per cent of the internal credits and prerequisites are focused on mobility, including the smart location of the new neighbourhood and the implementation of bicycle mobility, interchange points and shaded streets. These solutions were evaluated based on their relationships with critical mobility issues, providing a comprehensive solution that focuses chiefly on the connection system, accessibility and usability performance, control, and climatic impact.

Keywords
Sustainable mobility; GBC Quartieri protocol; Le Albere project.

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1. Introduction

As is widely acknowledged, cities consume 75% of the world's resources despite covering only 2% of the earth's surface (Mersal, 2017). Furthermore, cities house the majority of the world's population, with 2.3 billion individuals currently residing in urban areas (UN-Habitat, 2020), and are a significant driver of economic growth (Allam & Jones, 2021). According to the United Nations Sustainable Development Goals 2022 Report, over 50 per cent of the world's population currently lives in cities. By 2050, an estimated 70% of the world's population will reside in urban areas. Metropolitan environments drive economic growth and produce over 80% of the global GDP. Unfortunately, they also generate over 70% of global greenhouse gas emissions, contributing to noise pollution and creating heat islands while encouraging sedentary behaviour among their inhabitants (Nieuwenhuijsen & Khreis, 2019). Careful urban planning and management can support sustainable development and foster prosperous, inclusive communities (United Nations, 2022). Europe is the second most urbanised region, with a rate of 70%; North and South America surpass this with rates of 80% (Economist Intelligence Unit, 2012). The European Union (European Commission, 2014) and the United Nations (United Nations, 2015) have established climate targets and energy projects to tackle existing challenges. Additionally, the European Union's 'Cities of the Future' report highlights cities as hotspots for issues, but also as potential solutions.

Sustainable development and environmental considerations are crucial in effectively managing urban growth, offering scope for innovation, progress and change. Cities should review their approach to urban space, enhancing its quality and making urban transformation more viable. This requires the amalgamation of environmental sustainability objectives with those of urban planning, governance, economics and social inclusion (Gandolfi et al., 2014). As described in Goal 11, 'Sustainable Cities and Communities', it is necessary to convert urban centres into environmentally-friendly cities that offer inhabitants convenient housing, essential services, and reasonable, secure, and efficient transport choices. To achieve this, the proposed strategies include improvement of the local public transport system and a focus on groups that are more vulnerable, such as women, children, individuals with disabilities, and others (UN General Assembly, 2015). Moreover, it is imperative that cities implement strategies to mitigate their adverse effects on the environment. This can be achieved by advocating for the creation of secure and accessible green spaces and public areas whilst simultaneously prioritising cultural preservation (United Nations, n.d.).

In the field of mobility, the Global Mobility Report 2017 (Sustainable Mobility for All, 2017) illustrates that transportation is bound to expand as an increasing number of individuals and goods navigate urban centres. By 2030, it is predicted that transportation will escalate by 50% compared to 2015, causing the number of vehicles on the road to reach a total of 1.2 billion, which is twice that of the current amount. Given text is already adhering to the given principles. Therefore, here's the answer: Considering that the choice of today's mobility system determines how the territories of the future will develop, meeting the growing demand for mobility, if planned as done so far, has the potential to contribute to environmental degradation and increase air pollution levels in cities, as well as amplify the effects of climate change. The impact of mobility on our society cannot be underestimated, particularly with regard to our health and well-being. Issues such as greenhouse gas emissions, pollution of air, soil and water, along with traffic accidents, congestion and loss of biodiversity (European Commission, 2021) are just some of the costs we must consider.

Advocating sustainable mobility is crucial, as the European Council has defined in their European strategy, to make certain that transportation systems fulfil the economic, social, and environmental needs of society while minimising undesirable impacts on the economy, society, and the environment (Council of European Union, 2006). Furthermore, research indicates that social and economic impacts must be taken into account, in addition to environmental factors alone (Gallo & Marinelli, 2020). The development of this concept originates from the Aalborg Charter and its ten principles (1994), proceeding to the Leipzig Charter, which included the aim for

integrated urban development and governance in 2007, and culminating with the contemporary approach to urban mobility policies exemplified by the Sustainable Urban Mobility Plans (SUMP) (Vittadini, 2019).

To achieve a concrete improvement in sustainable mobility, it is essential to promote the adoption of new technologies and engage citizens to prefer environmentally friendly modes of transportation. This can be done with the participation of stakeholders who can contribute their ideas and expertise to the project process and thereby modify their mobility habits (Spadaro et al., 2023). The choice of travel mode (means, routes) is influenced by factors surrounding the existing mobility system and the perception of its inhabitants. Merely creating useful infrastructures is insufficient; the correct perception of their accessibility must also be established (Larco et al., 2012).

The implemented strategies incorporate incentives for employing environmentally friendly modes of transportation, measures to encourage public participation, communication, and public awareness programs. These efforts aim to influence the behavioural patterns of individuals towards alternative and sustainable mobility solutions (Ministero delle Infrastrutture e dei Trasporti, 2022).

It is crucial to evaluate current transport systems objectively with priority interventions in urban planning, both in Italy and Europe. Development and implementation of policies with site-specific and place-based approaches (Privitera, 2023) are necessary. The aim is not to prohibit car use, but to encourage the population to consider alternative modes of transport as primary choices (Banister, 2008). The pandemic has emphasised the necessity of examining current transport systems for their resilience and equitable nature (Beck & Hensher, 2020). A distinct shift in collective public transport usage is required as it contradicts the social distancing paradigm, causing users to resort to private, motorised transportation means (Privitera, 2023).

The primary concerns with mobility in urban regeneration comprise insufficient socially and environmentally optimal connection systems, inadequate accessibility and usability, ineffective management of climatic factors, noise, light and air pollution due to the use of private vehicles (Radogna, 2015), an outdated mobility system with a private car focus, and disorganised transport systems in urban centres (Francini et al., 2019).

In this context, sustainability protocols can assist by objectively evaluating individual buildings and improving their inherent qualities and connection with the environment. This encourages conscientious management of buildings within their context. These international systems have evolved to include neighbourhood, community and city-wide scales over time, enhancing overall sustainability; its are voluntary, widespread throughout the world, and enable a sustainability comparison using quantitative and/or qualitative parameters. Although addressed differently, transport and mobility are ubiquitous themes in all urban classification systems (Privitera, 2023).

Building on these reflections, this article aims to establish an assessment process that highlights effective strategies to tackle mobility-related issues and their interrelations by scrutinising the Italian GBC Neighbourhoods protocol. Indeed, one problem with sustainable redevelopment projects or sustainable neighborhood redesign interventions, in this case particularly in the context of sustainable mobility, is the difficulty of measuring their effectiveness in order to make informed decisions. Protocols analysis could be a useful tool in addressing this issue.

The text presents a structured contribution that begins with an exposition of the situation related to sustainability protocols on an urban scale and their connection with sustainable mobility. The GBC Quartieri protocol is given particular attention. Following this, a methodological proposal is presented to evaluate the sustainable mobility in a project. This is achieved by comparing critical issues related to mobility with the solutions proposed by the protocol. Finally, this method is used to evaluate a case study. In fact, by assessing the connectivity and accessibility of the Trento Le Albere neighbourhood with the city centre and main urban services, the evaluation of the project's success in meeting expectations was made possible. Although it has not been certified as a neighbourhood, it was designed prior to the development of the urban-scale rating systems mentioned earlier. The expansion of the former Michelin site in Trento is regarded as a significant

urban intervention in the northern region of Italy, encompassing roughly 11 hectares of land. The objective of employing over 300,000 cubic metres of ecologically sustainable technologies is to establish a novel residential district in the city.

2. Materials and methods

Since the introduction of the Japanese CASBEE Urban Development in 2006, several urban development rating systems have been created, including the British BREEAM Communities, the American LEED Neighbourhoods, and the Australian Green Star for communities. Additionally, the Italian GBC Quartieri was established in 2015. In 2016, the focus expanded to assessing entire cities, as the USGBC introduced LEED for Cities and Communities. The aforementioned led to the adoption of the digital platform ARC, which facilitates the ongoing monitoring and evaluation of the sustainability of the entire construction industry over time employing regularly updated indicators (Dall'O', 2021). In terms of scale, protocols distinguish between those covering larger spatial areas (neighbourhoods or districts) such as GBC Neighbourhoods and LEED for Neighbourhoods, and those that have established sustainability assessment and ranking frameworks at city and/or community level such as BREEAM Communities, STAR and LEED for Cities and Communities (GBC Italia, 2021).

The assessment mechanisms are voluntary and enable the comparison of various projects using weighted indicators and an evaluation grid (Yamany et al., 2016). The thorough certification procedure entails the third-party collection and evaluation of relevant documents. In general, the focus is to monitor ongoing sustainability trends by conducting self-assessments of policy effectiveness related to one or more sustainability objectives. This also involves comparing sustainable performance by incentivising virtuous emulative and competitive attitudes, and evaluating sustainability performance with reference to benchmarks to recognise certain levels achieved, particularly for territorial marketing and/or communication strategies (GBC Italia, 2021).

The protocols are closely linked to the territorial context of origin and rely on local legislation, rules, and cultural and social aspects (Francini et al., 2019). Various scientific contributions have adopted these protocols for different purposes. These range from a qualitative comparison of the energy and environmental sustainability of a building and urban construction project (del Bo, 2020) to the creation of a new definition of a sustainable neighbourhood (Codispoti, 2021). They also include an internal analysis of these tools to understand whether they can help a new settlement to become a truly more sustainable area that considers the needs of the society of the future (Papa et al., 2016), or whether they can be reused for the realisation of new protocols specific to new types of settlement (Volpatti et al., 2024). Criticism of urban rating systems includes concerns about the selection of internal indicators, which are subject to prior settings. Nevertheless, these constraints are overcome through continuous review and periodic evaluation of the system.

The study seeks to assess the GBC Quartieri protocol, which originated in Italy and drew inspiration from LEED for Neighborhood, but was adapted to the Italian setting. This tool is voluntary and market-driven, serving as both a guideline and assessment mechanism based on consensus. The aim is to optimise the utilisation of natural resources, endorse regenerative and restorative techniques, minimise negative repercussions to the environment and human health, and furnish superior indoor surroundings for edifice occupants. Every GBC and LEED rating system is arranged into two sections, prerequisites – the mandatory component, and credits – the section where points are awarded. Depending on the number of points achieved, a project attains a rating level of Certified (40-49), Silver (50-59), Gold (60-79) or Platinum (over 80) (Boschetto et al., 2022).

This standard offers a framework to aid planners, local authorities, developers, and investors with the integration and evaluation of sustainable design in the general planning of novel communities and regeneration schemes (Green Building Council Italia, 2023). The protocol was exclusively utilized for Euromilano's UpTown project in Italy, achieving the Gold level, a smart district situated in an area that encompasses the renovated Cascina Merlata, which is currently a service hub for citizens, in the north-west area of Milan. The new district covers an area of 900,000 square metres, with 300,000 square metres designated as parkland, and designed

to accommodate 12,000 residents. The project aims to promote sustainable mobility, social housing and neighbourhood services. Additionally, there will be a new railway station and improved public mobility (Euromilano S.p.A., n.d.).

GBC Quartieri comprises three main categories:

- *Smart Location and Linkage*, which incorporates measures to reduce negative environmental impact through functional mixite, appropriate access to public transportation, and utilization of existing districts. The selection of such areas facilitates a decrease in soil consumption and diminishes the requirement for constructing novel infrastructure. Consequently, this lowers the extension of impenetrable surfaces, which amplifies the likelihood of detrimental phenomena associated with rainwater management;
- *Neighborhood Pattern and Design* scrutinizes links, amenities, and the network of connections, thereby appraising infrastructure efficacy and urban densification. Community involvement in the design and planning process is emphasized in this section;
- *Green Infrastructure and Buildings* where the the objective is to reduce environmental impacts associated with construction, maintenance, and long-term management (Green Building Council Italia, 2015).

Regarding mobility and transport, the protocol includes numerous requirements and credits. Specifically:

- it recommends promoting public transportation;
- It is recommended to restrict the expansion of urban areas to decrease travel distances and frequency;
- There should be an emphasis on promoting cycling and walking by developing safe, visually appealing, and comfortable routes;
- It is also important to encourage community connections and internal connections for large-scale urban and territorial projects;
- To prevent soil consumption and related rainwater runoff, there should be a reduction in the development of car parking facilities;
- Incorporate recycled and reclaimed materials throughout the project;
- Utilise innovative systems to minimise light pollution.

3. Methodological proposal

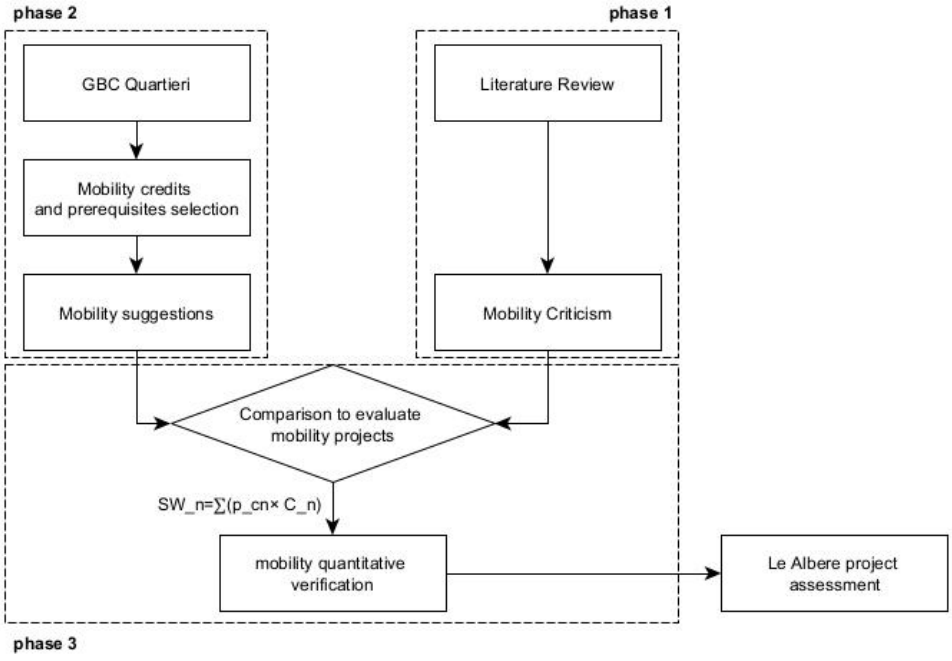

Fig.1 Flowchart of the proposed methodology

To quantitatively evaluate sustainable mobility in a project, the proposed methodology involves three phases: first, collecting critical issues related to the topic, as already exposed in the introductory section; second, analyzing the GBC Neighborhoods protocol parameters connected to sustainable mobility; and finally, comparing the results of the two phases using a weighting system. Le Albere di Trento can be evaluated upon completion using this method. The flowchart mentioned earlier can be seen in the following Fig.1.

From analysing the energy and environmental sustainability protocol at the urban scale of GBC Quartieri (Tab.1), it can be observed that a significant proportion of the credits and internal prerequisites pertain to mobility. These include the strategic placement of the new neighbourhood, cycling infrastructure, interchange points and shaded streets.

Smart Location & Linkage			
Code	**Description**	**min points**	**max points**
LCS_p1	Smart Location	X	
LCS_c1	Preferred Locations	1	10
LCS_c3	Access to Quality Transit	1	7
LCS_c4	Bicycle Facilities	1	2
LCS_c5	Housing and Jobs Proximity	1	3
Neighborhood Pattern & Design			
Code	**Description**	**min points**	**max points**
OPQ_p1	Walkable Streets	X	
OPQ_p2	Compact Development	X	
OPQ_p3	Connected and Open Community	X	
OPQ_c1	Walkable Streets	1	9
OPQ_c2	Compact Development	1	6
OPQ_c3	Mixed-Use Neighborhoods	1	4
OPQ_c5	Reduced Parking Footprint	1	1
OPQ_c6	Connected and Open Community	1	2
OPQ_c7	Transit Facilities	1	1
OPQ_c8	Transportation Demand Management	1	2
OPQ_c14	Tree-Lined and Shaded Streetscapes	1	2
Green Infrastructure & Buildings			
Code	**Description**	**min points**	**max points**
IES_c15	Recycled and Reused Infrastructure	1	1
IES_c17	Light Pollution Reduction	1	1

Tab.1 Selection of prerequisites and credits in GBC Quartieri regarding mobility: the lighter blue principles are indirectly related, while the darker blue principles are closely related

	Smart Location & Linkage		**Neighborhood Pattern & Design**		**Green Infrastructure & Buildings**	
	min points	max points	min points	max points	min points	max points
mobility connected	3	19	2	10	2	2
mobility closed connected	1	3	6	17	0	0
mobility	4	22	8	27	2	2
total	9	28	16	43	17	29
% mobility	44%	79%	50%	63%	12%	7%

Tab.2 Sustainable mobility weighting in GBC Quartieri is divided into internal main categories. Lighter blue principles are indirectly connected with mobility, while darker blue principles are closely connected with mobility. This is in accordance with the previous table

In fact, mobility-related sustainability holds significant importance within the protocol, particularly for the Smart Location & Linkage and Neighbourhood Pattern & Design categories, evidenced by high percentage values in Tab.2. Evaluating the protocol holistically, mobility-related credits account for between 33% (minimum points) and 51% (maximum points) of achievable scores.In this analysis, both the requirements and incentives that are directly related to sustainable mobility were considered, as well as those that indirectly support it, such as the compact development of the neighbourhood and adequate street lighting.

The issue of transportation is not unique to GBC Quartieri, but is a shared aspect among various rating systems, albeit with some variances. It is imperative that there is an enhancement of intermodal public transportation and an integration of alternative mobility systems into urban planning in order to achieve better organization in urban centers, as well as to reduce land use and tackle climate change (Francini et al., 2019). Furthermore, as planners, it is essential to evaluate the quality and not solely the amount of services given to citizens and stakeholders. Subsequently, it is vital to observe the effects of the project over a period of time to adjust tactics in response to the altered perception regarding the quality of life (Bosch et al., 2017). The monitoring activity implemented with GBC Neighbourhoods protocol necessitates skillfully weighing the introduced objectives to attain high-quality urban spaces. This involves providing an accurate depiction of prevailing conditions and then utilizing appropriate methodologies to accomplish the city's urban and environmental quality goals.

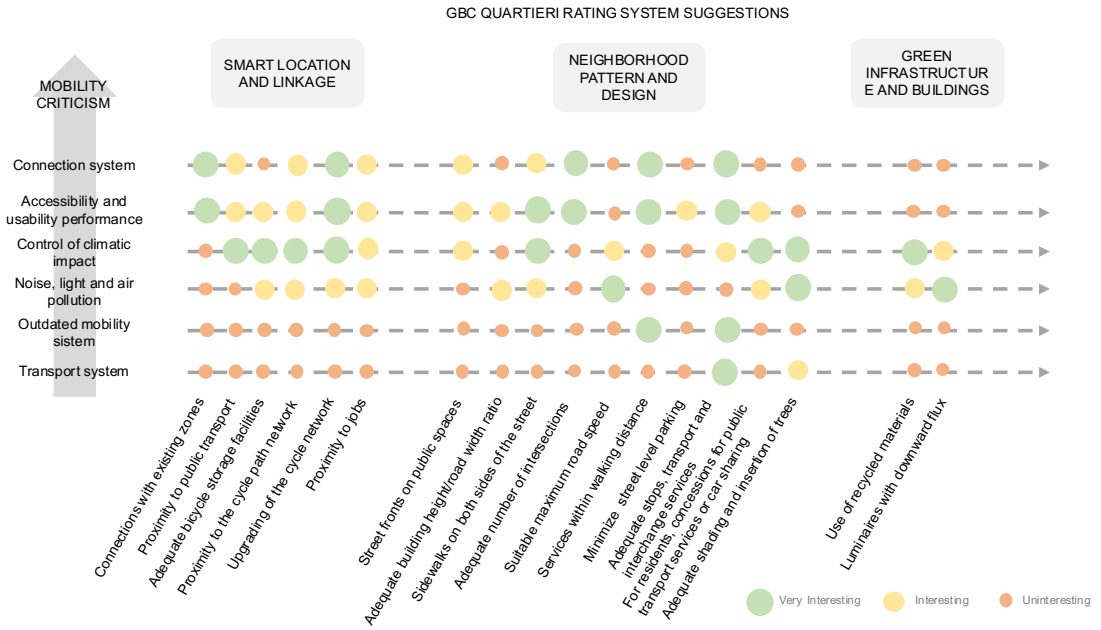

Fig.2 Linking the suggestions given by GBC Quartieri rating system to the mobility criticism described in the introduction

By thoroughly analysing the requests outlined in the GBC Quartieri protocol, recommendations for a sustainable transport and mobility design can be identified. These suggestions can then be linked to the crucial aspects highlighted in the introduction and addressed in the literature. In Fig.2, the evaluation of parameters is displayed, with suggestions grouped by their main category and further categorized based on their relevance to mobility criticism. In this way, it is possible to see how certain design suggestions are more or less related to mobility-related criticalities; alternatively, if read in the opposite direction, the possible solutions specified in the protocol can be found through the interest or lack of interest highlighted. Then, one can determine the extent of the relationship between particular design recommendations and matters related to mobility, or alternatively, recognise potential resolutions detailed in the protocol depending on the degree of interest expressed. This analysis is limited by the subjectivity of the planner conducting the study. Only after numerous

analyses can the findings become generalizable and repeatable, or they should be derived from a participatory approach (Delsante, 2016). The analysis is limited by the subjectivity of the planner conducting the study. This approach aims to meet the criteria of objectivity (clarity, ease of comprehension, precision, and unambiguity), relevance, reproducibility (systematic observance), and validity (with), the possibility of verification, representativeness at the city level, comparability over time, and accessibility through the use of existing databases and data. The range proposed varies in interest (from very interesting to uninteresting), depending on the degree of correlation and interconnection between the criticism of mobility and the solution offered in the protocol.

To assess the project outlined below, quantitative verification is necessary in addition to qualitative and descriptive analyses. Relying solely on attainable credit values is inadequate as it could result in an assessment that does not align with our goals. The aim is to evaluate the success or failure of the projects in meeting mobility requirements by offering solutions to commonly identified key issues highlighted in the introduction through the protocol currently under review. To achieve this, weights to the reports exhibited in Fig.2 were allocated, which are then multiplied by the number of credits suggested in the protocol or by 1 in the case of a prerequisite, illustrated in (1).

$$SW_n = \sum (p_{cn} \times C_n) \quad (1)$$

Where:

- SW_n is the weight of the solution under analysis (for example, transport system or accessibility and usability performance);
- p_{cn} is the weight of the criticism assessed in Fig.2. If the link is deemed highly interesting, it is given a value of 5; if interesting, a value of 3; and if uninteresting, a value of 1;
- C_n is equal to the maximum number of credits suggested by the protocol or 1 in case of a prerequisite.

The resulting table shows GBC Quartieri's primary focus on connection system (149 weight points), accessibility and usability performance (191 weight points), climate impact control, and noise, light and air pollution (215 weight points). Conversely, less importance is placed on outdated mobility (63 weight points) and transport system concerns (63 weight points).

The limitations of the method are attributable to the approximations employed, ranging from the subjective selection of credits and prerequisites related to mobility, to the weighting of the interconnections between criticalities and solutions provided by the protocol. To explore this further, minor weights of 1, 2 and 3 were tested for p_{cn} within formula 1, leading to a highly comparable conclusion.

4. Results

To assess the outlined methodological system, it is applied to the Le Albere project case study. This is a project situated in Trento that was commissioned to RPBW-Renzo Piano Building Workshop in 2013. Its objective was to transform an abandoned and heavily polluted industrial site into a green landscape. This new, highly technical district rejuvenates an eleven-hectare area that was once the site of the Michelin factories until 1998. This transformation was made possible due to the proximity of the two main infrastructures, the railway, and the Adige River.

The project aims to achieve sustainability, compatibility with the environment, and energy conservation. Its objectives include the revitalization of the river belt and restoring the connection with the city that was previously hindered by the railway barrier. Its objectives include the revitalization of the river belt and restoring the connection with the city that was previously hindered by the railway barrier. This impediment has been eradicated with a system of pedestrian and vehicular underpasses, enabling residents to traverse old and new neighbourhoods seamlessly. The presence of ponds, ditches, and small canals emphasises the need to connect the city with the river. The main idea was to merge the buildings to the east, close to the railway line, in

contrast to the vast park on the western side, which borders on the Adige River, separated by a long tree-lined avenue that stretches up to 300 metres.

The functional mixity characterises both the composition of the individual buildings, encompassing various typologies ranging from residential to office spaces, shops, and cultural venues, as well as the entire district, which includes the Science Museum, a multipurpose centre, and a hotel.

GBC Quartieri				Mobility Criticism weight SW_n					
Smart Location & Linkage				**Connection system**	**Accessibility, usability performance**	**Control of climatic impact**	**Noise, light, air pollution**	**Outdated mobility system**	**Transport system**
Code	**Description**	**min**	**max**						
LCS_p1	Smart Location	X		5	5	1	1	1	1
LCS_c1	Preferred Locations	1	10	30	30	50	10	10	10
LCS_c3	Access to Quality Transit	1	7	7	21	35	21	7	7
LCS_c4	Bicycle Facilities	1	2	6	6	10	6	2	2
LCS_c5	Housing and Jobs Proximity	1	3	15	15	15	9	3	3
Neighborhood Pattern & Design									
Code	**Description**	**min**	**max**						
OPQ_p1	Walkable Streets	X		3	3	3	3	1	1
OPQ_p2	Compact Development	X		3	3	3	1	1	1
OPQ_p3	Connected and Open Community	X		1	3	1	3	1	1
OPQ_c1	Walkable Streets	1	9	27	45	45	27	9	9
OPQ_c2	Compact Development	1	6	30	30	6	6	6	6
OPQ_c3	Mixed-Use Neighborhoods	1	4	4	4	12	20	4	4
OPQ_c5	Reduced Parking Footprint	1	1	5	5	1	1	5	1
OPQ_c6	Connected and Open Community	1	2	2	6	2	2	2	2
OPQ_c7	Transit Facilities	1	1	5	5	3	1	5	5
OPQ_c8	Transportation Demand Management	1	2	2	6	10	6	2	2
OPQ_c14	Tree-Lined and Shaded Streetscapes	1	2	2	2	10	10	2	6
Green Infrastructure & Buildings									
Code	**Description**	**min**	**max**						
IES_c15	Recycled and Reused Infrastructure	1	1	1	1	5	3	1	1
IES_c17	Light Pollution Reduction	1	1	1	1	3	5	1	1
				149	**191**	**215**	**135**	**63**	**63**

Tab.3 Table illustrating the distribution of solutions weight of mobility criticism in GBC Quartieri protocol, through the use of formula 1. Colours are the same used in Figure 2

The buildings situated in a line are intended for office and management functions, while the courtyard blocks are reserved for 300 residential flats. With the exception of the museum and multifunctional center, all of the buildings are no more than 18 meters in height, matching the size of the previous industrial establishments. The roofs boast sharp blades, sloping like the Dolomites, and are equipped with sizable solar-powered systems. At an infrastructure level, the project includes underpasses and connections, as well as avenues that mirror the proportions of the streets of the Renaissance palaces found in the city centre. Vehicular traffic is limited to the main north-south artery, and most parking lots are underground, allowing for more green spaces and pedestrian areas (Ciccarelli, 2014) (Malvasi, 2013). The criticism of this project centres around:

- The promised creation of a "river park" open to citizens did not materialize;

- High rents for residential properties have resulted in low occupancy rates, with around 50% of them remaining unoccupied (Sanò et al., 2021);
- The residential area has become a temporary shelter for marginalised individuals who seek accommodation for the night. Although the neighbourhood is bustling with young professionals, tourists, students and families during the day, it is quiet and almost deserted at night (Sanò et al., 2021).

In regards to rating systems, the MUSE museum building has received certification. Specifically, it has obtained the gold-level LEED New Construction v 2.2 certification, with the following performances: 10/14 for sustainable site, 5/5 for water management, 6/17 for energy and atmosphere, 6/13 for materials and resources, 10/15 for internal environmental quality, and 5/5 for innovation design (Green Building Council Italia, 2016). The system achieved certification through the implementation of geothermal probes, solar cells, and rainwater harvesting.

GBC Quartieri			Mobility Criticism weight SW_n					
Smart Location & Linkage			Connection system	Accessibility, usability performance	Control of climatic impact	Noise, light, air pollution	Outdated mobility system	Transport system
Code	**Description**	**Le Albere Points**						
LCS_p1	Smart Location	X	5	5	1	1	1	1
LCS_c1	Preferred Locations	8	24	24	40	8	8	8
LCS_c3	Access to Quality Transit	5	5	15	25	15	5	5
LCS_c4	Bicycle Facilities	2	6	6	10	6	2	2
LCS_c5	Housing and Jobs Proximity	2	10	10	10	6	2	2
Neighborhood Pattern & Design								
Code	**Description**	**Le Albere Points**						
OPQ_p1	Walkable Streets	X	3	3	3	3	1	1
OPQ_p2	Compact Development	X	3	3	3	1	1	1
OPQ_p3	Connected and Open Community	X	1	3	1	3	1	1
OPQ_c1	Walkable Streets	9	27	45	45	27	9	9
OPQ_c2	Compact Development	3	15	15	3	3	3	3
OPQ_c3	Mixed-Use Neighborhoods	4	4	4	12	20	4	4
OPQ_c5	Reduced Parking Footprint	1	5	5	1	1	5	1
OPQ_c6	Connected and Open Community	1	1	3	1	1	1	1
OPQ_c7	Transit Facilities	1	5	5	3	1	5	5
OPQ_c8	Transportation Demand Management	1	1	3	5	3	1	1
OPQ_c14	Tree-Lined and Shaded Streetscapes	1	1	1	5	5	1	3
Green Infrastructure & Buildings								
Code	**Description**	**Le Albere Points**						
IES_c15	Recycled and Reused Infrastructure	0	0	0	0	0	0	0
IES_c17	Light Pollution Reduction	1	1	1	3	5	1	1
			117	**151**	**171**	**109**	**51**	**49**

Tab.4 Table illustrating the distribution of solutions weight of mobility criticism in Le Albere project, through the use of formula 1. Colours are the same used in Fig.2

Upon examination of the previous paragraph on Le Albere, it is feasible to assess potential enhancements that can be implemented in the neighbourhood. Specifically, although the plan was designed before the introduction of neighbourhood-scale rating systems, it possesses ample public spaces, is well-linked, enjoys good public transport access and adequate lighting. It should be noted that, to enhance the facility, the protocol proposes supplementing additional bicycle storage units that are secure and safe, utilizing sustainable materials for any future constructions, and enhancing connectivity with the current zones.

Turning to the quantitative evaluation proposed above, it can also be seen that the project obtained, through the use of formula 1 and replacing the maximum C_n credits with those actually obtainable from the project, according

to information gathered from reference publications, a shortlist of solutions that come close to the protocol under consideration, without shifting too much to some solutions to the detriment of others (Tab.4).
Further analysis of the obtained data reveals that the project fulfills almost 80% of the mobility requirements specified in the protocol. Better performance is achieved for obsolete mobility systems and for mitigating noise, light and air pollution. However, it is less effective for the transportation and connection systems (Fig.3).

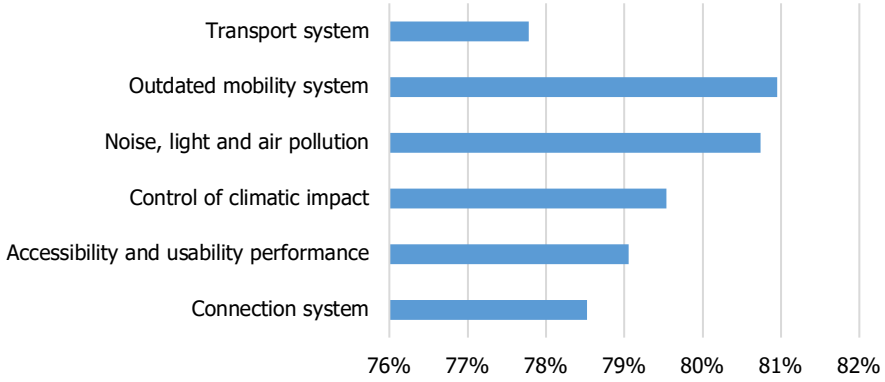

Fig.3 Graph showing the percentage of mobility criticisms addressed by the Le Albere project solutions

3. Conclusions

In the context of sustainable development and environmental concerns regarding urban growth, local transformation and redevelopment initiatives should aim to minimize negative impacts by evaluating the environmental, social and economic aspects. Consequently, it is crucial to reconsider transport planning and establish policies that assess the system of connections, organization, accessibility, environmental pollution, noise pollution and light pollution. Urban-scale sustainability protocols can aid planners and lawmakers in assessing and contrasting distinct projects. This study assesses the effectiveness of the GBC Quartieri protocol in transport-oriented contexts. The protocol, currently implemented in only one case in Italy, is analysed using a method that evaluates the internal characteristics of each solution provided for the critical issues found in mobility literature. The protocol's recommendations account for more than half of the overall achievable score and successfully address existing concerns regarding improvements in this sector.
Then, in order to be able to quantitatively analyse an actual project, the answers to the critical questions collected on mobility were weighted within the protocol. In this way, the Le Albere case study in Trento could also be analysed and checked in terms of the objectives achieved, with the overall result being a very good one that could be improved through a better implementation of the transport system and connections with the existing city.
In general, noteworthy outcomes were observed:

- It is necessary to monitor implemented projects and update them to respond to new environmental, social, and market challenges. Indeed, although the Le Albere project exhibits high-level characteristics, it requires further improvement to address the contextual needs articulated in the criticism of its description, which was only identified post-implementation;
- Urban planning is often evaluated as a secondary consideration to single building construction, yet for large complexes, it should be the primary theme to address as it can create marketing appeal and attractiveness;
- To enhance transportation and mobility and assess the attainment of 50% credit, it is crucial for the public sector to consider the implementation of these evaluation systems at the design and maintenance level in the long term.

For future implementations, the proposed method visible in Fig.4 could be used to compare this project with other neighbourhood redevelopment projects or to assess the internal attributes of other urban-scale protocols like BREEAM Communities or CASBEE Urban Development.

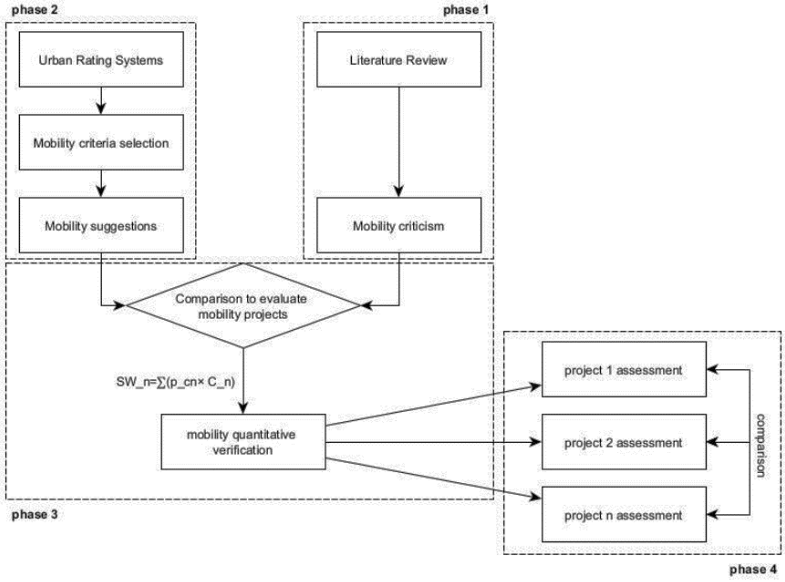

Fig.4 Generic flowchart of the proposed methodology for future implementations

The suggested approach may be modified by tweaking the allocated weights or overhauled completely to tackle any additional issues by commencing from scratch to compile a list of credits and prerequisites pertaining to the topic, scrutinising the provision of solutions, allocating weights and scrutinising current or ongoing projects.

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Image sources

Figg.1 - 4: Authors' elaboration

Author's profile

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