ENVISIONING RESILIENT CITIES for a POST-PANDEMIC ONE HEALTH FUTURE

REsilienceLAB

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The manuscripts in this publication exceeds the contributions to the initial conference. It highlights a variety of other inputs, opinions, points of views, and works of several citizens, international organizations, public institutions, NGOs, NPOs, associations, independent researchers, research centers, universities, and academic institutions from all over the world, who have all come together to envision resilient cities for a post-pandemic one health future.
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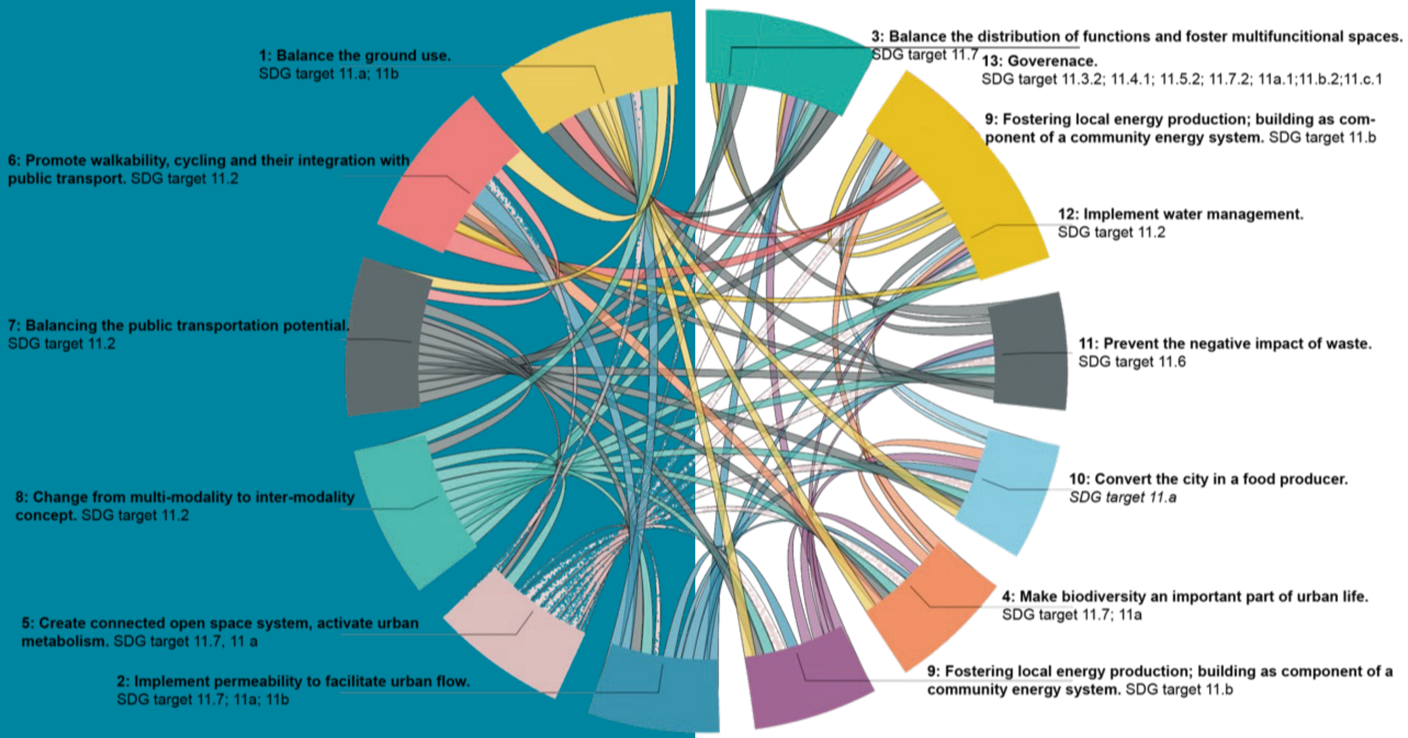
URBAN MORPHOLOGY, PERFORMANCE INDICATORS, URBAN DESIGN, URBAN HEALTH



Design Ordering Principles (DOP), their connections with each other, and its correlation with Sustainable Development Goals. Source: IMM Design Lab

[SCh5] Assessing Link of Urban Morphology and Health. A case study in Milan

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ABSTRACT

Despite some previous efforts to study the relationship between urban design and health, the COVID-19 pandemic has attracted more attention on this topic, including all living beings. It has also created awareness of the urgency of reconsidering how cities are designed and lived in.
Therefore, the ways of design more resilient cities and rehabilitate them by transforming them into healthier ones and making them become prepared for any possible similar risks in the future are fundamental for post-pandemic cities. This link between cities and health (including mental and physical) might be related to urban morphology, besides environmental and social parameters.
This study aims to evaluate the role of the built environment on health and well-being, which affect not only the process of the spread but also the recovering process. In order to achieve this aim, the problem is precisely investigated by focusing the health-related subjects in the context of IMM (Integrated Modification Methodology), which is a holistic, model-based, and objective methodology.
This article will present the metrics and indicators to understand the weak parts of the existing structure, and DOPs which could be the items in the design process of a healthier and more resilient city for the post-pandemic era.
The abandoned railway yard of Farini and surrounding in Milan has been selected as a case study to implement the methodology and eventually make evident how to improve a proposed masterplan.

1. Introduction

Since the COVID-19 pandemic is a global challenge in many aspects, new research questions have raised in many fields, including architecture and urbanism. This pandemic crisis gave the opportunity to investigate if the cities are resilient for crisis. It is not the first health issue humanity faced, there were other contagions before: malaria, plague, Spanish flu, and many other infection diseases. The city has also role in some chronic diseases such as respiratory infections, cardiovascular, and lung diseases.

Before the pandemic, literature related to cities and health was quite limited. There are different risk factors in the urban environment which may cause a chain relation and has negative impact about epidemiology of emerging infectious diseases. For instance, poor housing can lead to proliferation of insect and rodent vector diseases and hence inadequate water supplies as well as sanitation and waste management. Additionally, overcrowded housing in high-density populations in the slums can be a breeding ground for some infectious diseases such as tuberculosis. Another risk factor is the density of inhabitants and the close contact between people. This areas in cities are potential hot spots for rapid spread of merging infectious diseases e.g., severe acute respiratory syndrome (SARS) and the avian flu (Neiderud, 2015).

As National Intelligence Estimate highlighted, environmental and climate change has negative impact on malaria; migration and urbanization have on HIV-AIDS (National Intelligence Council, 2000). Regarding the malaria migration, urbanization, socioeconomic conditions, and a lack of adequate communication between relevant stakeholders were defined as the main obstacles to control the diseases effectively (Enwereji, 1999).
Urbanization and the growth of megacities are two of demographic factors have impact on health (Institute of Medicine 2003, 6). Increased population growth and urbanization, much of it unplanned, has contributed greatly to the dramatic increase in some species of mosquito abundance that infect people diseases (Institute of Medicine, 2003, 120). Once any infectious virus appears in a major urban area, it spread through transportation ways and causes local, national, or even global distribution in only a matter of days.
As insights from the pre-COVID-19 researches, it can be said that there was a consensus of large urban areas are more vulnerable to transmission of infectious diseases. Based on the accelerated

research interest in last two years about the relation between COVID-19 and territorial characteristics, many key factors considered as effective in pandemic consequences. In the existing studies conducted so far, some factors have been investigated which may affect the contagion of the COVID-19. These factors could be classified into four different categories i.e., environmental quality, socio-economic impacts, management and governance, and transportation and urban design (Sharifi and Khavarian-Garmsir, 2020). Even the parameters besides the last category, are inevitably connected to the approach of architecture and built environment. Therefore, the existing situation which comes from the global coronavirus pandemic crisis conditions points out the urgency of rethinking the way of how urban areas are built, maintained, and lived in.

Some cities have taken some actions such as investing to cyclability, considering social distances as a necessity in urban life, or building shelter for homeless people. However, these solutions are not efficient for long-term. Each of these issues highlights to changes in urbanization after pandemic to offer inhabitants healthier, resilient, and sustainable environments without risk factors like high air pollution and as a result, a life with low possibility to have chronic and/or epidemic diseases. Another result of pandemic is the tremendous increase in online shopping since people do not opt for going to supermarket or commercial shops to prevent social contact with possible infected cases. This issue should make all related actors think about proximity of shops in urban environments. A study (Fezi, 2020) conducted in the context of health engaged urbanism and its multi-scale interpretation about different key attributes. For instance, it highlighted how the shop distribution in the cities affects proximity shopping and in turn the possibility of preventing spread at urban scale. Another novel research (AbouKorin et al., 2021) measures the effect of urban morphology on transmission in European cities. It is found that cities with linear morphologies have the lowest infection rates in comparison with the ones with gridal and radial formed cities.

This research used IMM (Integrated Modification Methodology) to a selected area in Milan, the Farini railway yard and its surrounding. In this paper, only the parts that shows the relation between urban morphology and health issues have been shown from the context of a comprehensive project.
Briefly, the existing structure and the environmental performances of the project area is represented numerically by metrics and indicators respectively. Afterwards, some principles amongst Design Ordering Principles are explained that taken into account to produce masterplan. Last but not least, an optimization way represented to improve the proposed masterplan which based the performed analysis. With the enlightenment of metrics, indicators, and Design Order Principles this paper investigates and applies alternative evaluation methods and urban design solutions to overcome the urgencies that emerged during the COVID-19 pandemic for the future.

2. Methodology

The methodology of this research belongs to the framework of IMM. Due to its holism and wide context, the most related parts to the scope of this paper have been selected to represent in this paper. It consists of 4 different phases and this paper covers all the phases partially.
The main idea of this methodology is based on that urban design can directly play big roles on the quality of our lives and the environment that we live in. It has a multi-layer, multi-scale, and holistic approach. IMM approach to sustainability is aligned to the UN Sustainable Development Goals 2030.
The required data is obtained from different sources or obtained by the authors manually. The data sources are as follows: DBTR (Topographic Regional Database) of Lombardy, SIT (Territorial Information System) of the Municipality of Milan, and Daytime Surface Temperature Hotspots by SIT. Additionally, the analysis which includes demographic data is performed the data provided by ISTAT (Italian National Institute of Statistics).
The Farini area, located in the north of Milan, is used as the case study for this research (Figure 1). It is one of the abandoned railway yards in the city. It could be read as a huge void due to the fact that a big part of the land is occupied by rails. This area is under development by the Municipality of Milan.

2.1. Assessment Metrics
The quantitative metrics have an important role to understand and interpret the existing structure of the area through IMM framework. The values depend in the range from 0 to 1, they have been normalized in need. There are six spatial assets to represent each Key Category (Tadi et al, 2020).
Key categories show a functional symbiosis between all subsystems (i.e., void, volume, types of uses and links) regarding the functional interdependency between them (Biraghi et al, 2017). In this study, only the most related metrics with health issues have been presented as shown in Table 1.
The quantitative metrics in table 1 shows spatial issues that are related with health of living beings directly or

[SCh 5] Figure 1. Location of local project area and surrounding. Source: author elaboration based on Google Earth aerial view

[SCh 5] Table 1. Selected metrics among all the 42 metrics of IMM. Source: author elaboration

	Key Category	Brief Definition		Metric	Input
1	Porosity	different arrangements of buildings and void to measure the compactness level	1	Void Volume Ratio	void volume/total volume
			2	Net Floor Ratio	floor area/block area
			3	Net Courts Area Ratio	closed court area/block void area
2	Permeability	how structure to let people move into the urban network	4	Directness	linear distance/network distance
3	Accessibility	the uneven distribution of functions and public transportation stops	5	Number of Key Functions	number of activities within the catchment area of 5 min.
			6	Network Measure	pedestrian areas within 2.5 min public transport catchment/total area.
			7	Attractors	distribution of employees in each census section
			8	Generators	distribution of the population for each census section
4	Interface	movability in morphological cavities	9	Block Built Parameter	block perimeter with buildings aligned/total block perimeter
5	Proximity	morphological quality that urban context offers to walk through primary types of uses	10	Mixed-use Share	number of employees/ number employees and residents
			11	Surface Share	surface of window-shops/total street level surface
			12	Simultaneous Proximity	residents in proximity area/total residents
			13	Street Discomfort Ratio	length of comfortable streets/total length of streets
6	Effectiveness	how built volumes are covered by walkable area of transportation simultaneously	14	Employees Density	number of employees per unit of area
			15	Volume Density	total Building Volumes per unit of area
			16	Population Density	number of residents per unit of area
7	Diversity	emerged by superimposition of city elements: types of uses, voids, volumes, and links respectively	17	Number of Types of Uses	total amount of Type of uses
			18	Diversity Index	total types of uses/total number in a given context
			19	Coverage	total type of uses (except residential) x total floor areas (except residential) over the total building's floor area

indirectly. Void Volume Ratio, Net Floor Ratio, and Volume Density give clues about the physical structure of built area that might be related to urbanization activities. Net Courts Areas Ratio and Block Built Parameter are alternative ways to study the number of open areas in built environments. Directness and Street Comfort Ratio show how users can walk or cycle easily and comfortably, instead of using public transportation.
On the other hand, Number of Key Functions, Network Measure, Mixed-use Share, Surface Share, Simultaneous Proximity, Number of Types of Uses and finally Diversity Index makes evident different phenomenon about the activities both in terms of the function of entire building (i.e., office, commercial, ...) and the various ground floor types (i.e., bakery, pharmacy, bar, market, ...). All these metrics points out a way to understand how close contact might increase between people. On the other hand, Attractors, Generators, Employees Density, and Population Density considers the main subject in the city, the people in terms of user density. Whereas Attractors refer to number employees in the area, Generators represents number of residents in the area.

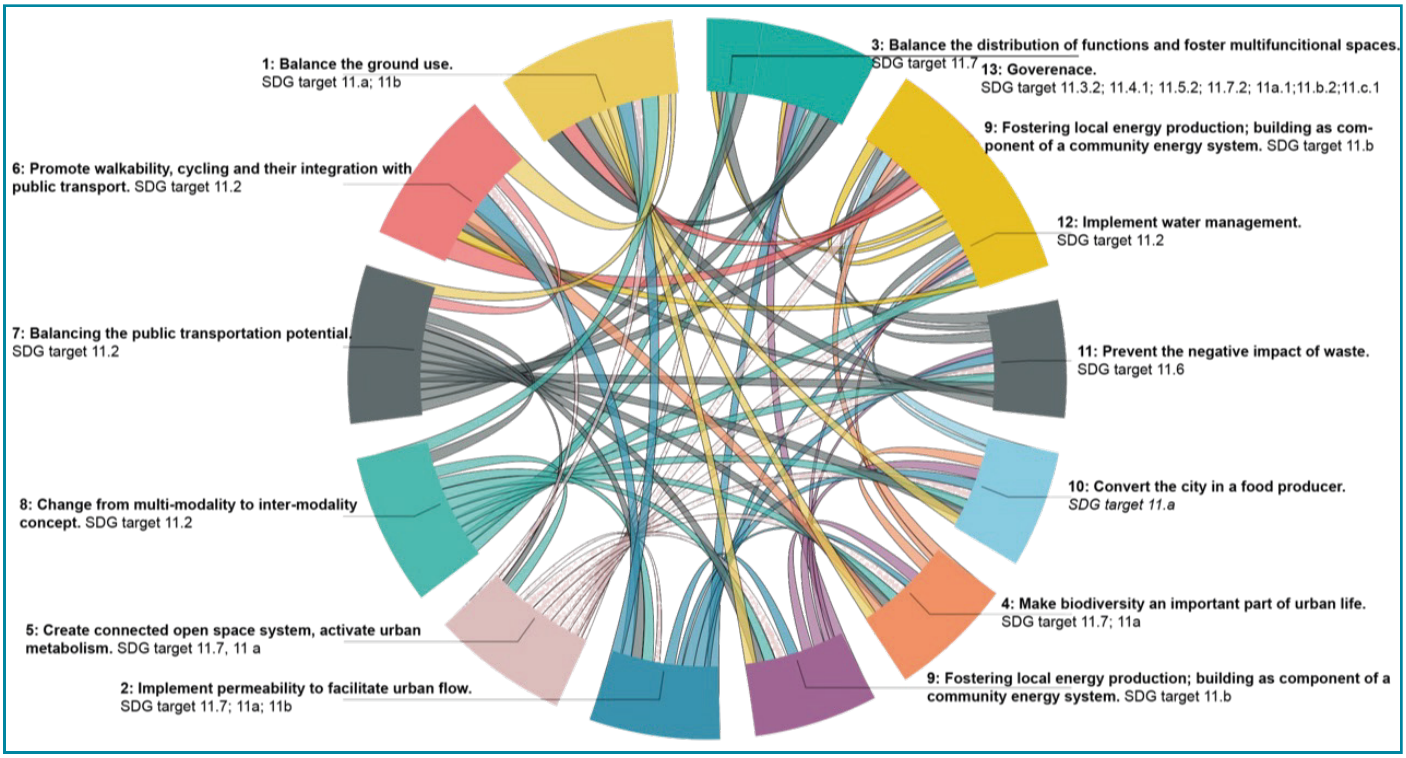
2.2. Performance Indicators

Indicators are a core set of elements based specifically on environmental themes but interlinked with other social and economic themes. They are used in the IMM, for com¬paring the characteristic performance of the system, prior to and after the transformation design process (Tadi and Manesh, 2014). Performance indicators are tools which are useful to measure energy and environmental performance and they are almost 150 in total as a spreadsheet produced by IMM Design Lab. The choice criteria among all indicators as the same criterion considered in the case of assessment metrics: having strong ability to represent the link between urban and health.

[SCh 5] Table 2. Selected Performance Indicators among 150 of IMM indicators. Source: author elaboration

DOP		Indicators	Inputs
1	1	SDG 11.3.1 Ratio of land consumption rate to population growth rate (UN-Habitat, 2020a)	Land consumption rate/population growth rate
	2	SDG 11.1.1 Proportion of urban population living in slums, informal settlements, or inadequate housing (UN-Habitat, 2020b)	Number of people living in Slum/Informal Settlements households, inadequate housing households and total population
	3	Number of buildings per hectare	Number of buildings/total land area
	4	Urban Built density	Total volume of buildings/total area
	5	Block Density (Salat et al., 2011)	Number of blocks in each area/total area (ha)
2	6	Heatmap Street indicator	Global Temperature (in C°), Length-Temperature product (mXC°), Total Length (in m)
3	7	Ratio between numbers of residents and activities	Number of residents/number of activities
	8	Housing diversity	Low-income housing/Total housing (in 2009)
4	9	Proportion of the resident living 300m of a park (Chan et al., 2014)	Residents live in in a 300 m distance from parks/total population
5	10	Extent and number of parks (%)	Numbers of parks/tot area ha
	11	Lawn Cover Ratio (LCR) (%)	Total green surface/total open surface
	12	Percentage of Residents within Walking Distance of a Recreation Area %	Residents live in in a 400 m distance from recreation areas/total population
6	13	Length of biking roads	The proportion of roads dedicated to bike.
	14	Number of bike parking spots	Number of parking spots/total residents
	15	Bike Sharing	Total number of bike sharing points
	16	Population with walkable access to bike trails	Population within 400 m to bike trails/total population
	17	Number of key functions in a walking distance from residential buildings (ITDP, 2018)	The number of key functions located in a 300 meters distance from the residential area
	18	Car free or minimal car traffic streets (ITDP, 2018)	The km of street dedicated to minimal car traffic or car free street
	19	Pedestrian street paths - walkways (ITDP, 2018)	Total pedestrian street area/total street area
	20	Number of people that are within walking distance of frequent transit stops (ITDP, 2018)	Population within 5 min catchment area from public transport stop/total population
	21	Physically permeable frontage. Number of entrances per 100 meters of block frontage (ITDP, 2018)	Number of entrances/numbers of 100*100 blocks
	22	Sidewalks that are lined with continuous ground-floor activity (ITDP, 2018)	Length of sidewalks face with activities/Total length of sidewalks
	23	Shade and shelter (ITDP, 2018)	Area of canopy of trees and area of shadow elements/total area
	24	PM_{10} Annual average concentration in Milan (UN-Habitat, 2020)	Level of fine particulate PM_{10}
	25	$PM_{2.5}$ Annual average concentration in Milan (UN-Habitat, 2020)	Level of fine particulate $PM_{2.5}$
	26	NO_2 Annual average concentration	Level of fine particulate NO_2
10	27	Number of Urban farms within a given locale/community (Pansing et al., 2013)	Number of community gardens in the study context
	28	Access to community gardens (Pansing et al., 2013)	Population within 400 m to community gardens/total population

[SCh 5] Figure 2. Design Ordering Principles (DOP), their connections with each other, and its correlation with Sustainable Development Goals. Source: IMM Design Lab



2.3. Design Order Principles (DOPs)

DOP is the acronym of Design Order Principles, and they are 12 in total as represented in figure 2. They are not just a list, more like a network of targets. Design Order Principles include a variety of interactions and all of them are related with each other. DOPs are correlated with the Sustainable Development Goals and especially 11th one (Sustainable Cities & Communities) is directly related with this field. All DOPs are related to the subject of this research with different degrees of relevance hierarchically. 7 DOPs have been selected to present as the most integrated ones.

1. Balance the ground use: Its aim is to prevent the land degradation. This DOP is correlated with the UN's SDG target 11.a and 11.b. SDG 11.a is Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city. SDG 11.b is Number of countries with national and local disaster risk reduction strategies. Land use, community design, and transportation systems substantially impact local air quality, water quality and supply, traffic safety, and physical activity (Fallon and Neistadt, 2006). Hence both targets have inevitable relationship to public health, a holistic urban plan have to be implemented in all cases.The land in the case of Farini area is currently occupied by disused railways. Main aim is to transform disused railway yard into commercial, business, cultural and residential areas with the integration of open public areas and corridors.

2. Permeability to facilitate urban flow: This DOP is correlated with SDG targets 11.7 that provide universal access to safe, inclusive, and accessible, green, and public spaces, particularly for women and children, older persons, and persons with disabilities. Accessibility to green and public spaces is beneficial for both mental and physical health (Velarde et al, 2007). Everyone in the area should be able to reach these areas without any obstacle. To make this access possible for both pedestrians and cyclers became more important since the transmission risk of contagious diseases by close contact might increase in indoor and crowded areas such as public transportation vehicles.

3. Balance the distribution of type of uses and foster multifunctional spaces: This DOP is correlated with the UN's SDG target 11.7 as previous. Balance of distribution of several activities is more than mixing them. A proper distribution should provide simultaneously with the need of mixing them quantitative property and to arrange them morphologically. As a quantitative property, this balance could create safety and livability, improve accessibility to work for employees and services for all the people in the area. Even if a dominant function of a building is residential, it should include various functions at the ground floor level such as baker, market, or several shops. If this principle is implemented, to come together and form a crowd in closed areas, correspondingly close contact, would be prevented.

4. Make biodiversity an important part of urban life: The considerations are to develop urban green infrastructures as recreational opportunities and get benefits from them by enhancing biodiversity in terms of its environmental benefits such as cleaning water, air, and soil. In this case, five different classes of main green areas are proposed as represented in figure 3b: public green area to connect all existing and proposal green system; community garden to be managed by residents, botanic garden that includes a wetland zone, a buffer line with railways and the railway ecosystem itself. And each of these classes considered which species could be best solution for the environmental concerns. Besides environmental benefits, consideration of the arboreal properties, the species were chosen because of their longevity, the characteristics of flowers and fruits, the richness for the flora and for ecological and aesthetic characteristics to create colorscape to improve aesthetics and psychological impacts. During the pandemic, physical and even visual interaction with living plants is beneficial for mental health (Gola et al, 2021).

5. Connected open space system, activate urban metabolism: To create a strong connection between the intervention area and the surrounding in the city through green bridges that are also used for making accessibility easier for not only motorized vehicles but also bikes and pedestrians. To activate urban metabolism, existing green composition is defined, and they are tried to become a part of this green and open system at two different scales (figures 3a and 3b). However, it is possible to connect with some green corridors, as represented in figure 3a. The existing active railway yard is evaluated as railway ecosystem, since this land is a part of the urban ecological corridors that flank the infrastructures and an open system that promises rich urban biodiversity both for flora and fauna. This event creates a chain effect and improve air quality of the neighborhood as well due to the capability of decreasing pollution levels of plants (Lazzari et al, 2018). This

[SCh 5] Figure 3. (a) Open green corridors at intermediate scale and surrounding (b) Green network at local scale in relation to surrounding. Source: author elaboration

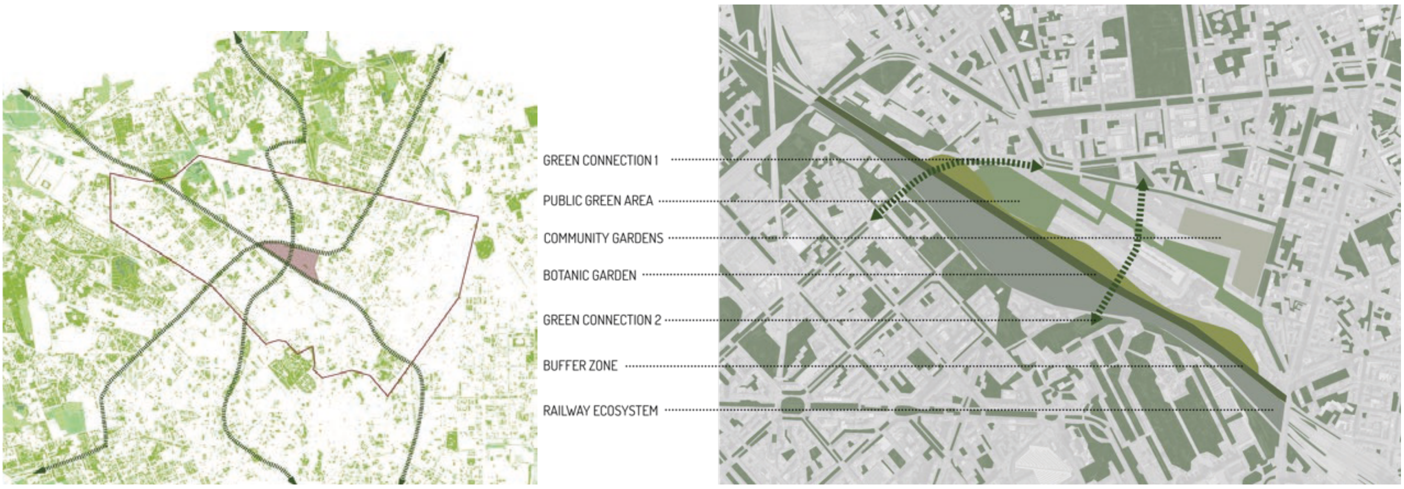
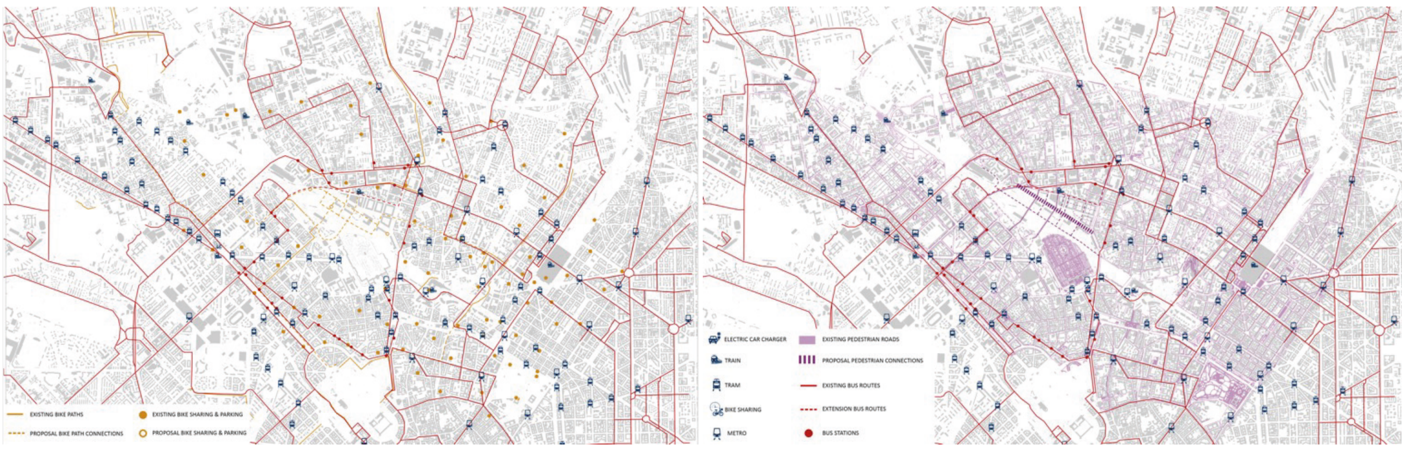


Figure 4. Intermediate scale (a) Cyclability proposal (b) Walkability proposal. Source: author elaboration



principle provides improvement in urban environmental quality.

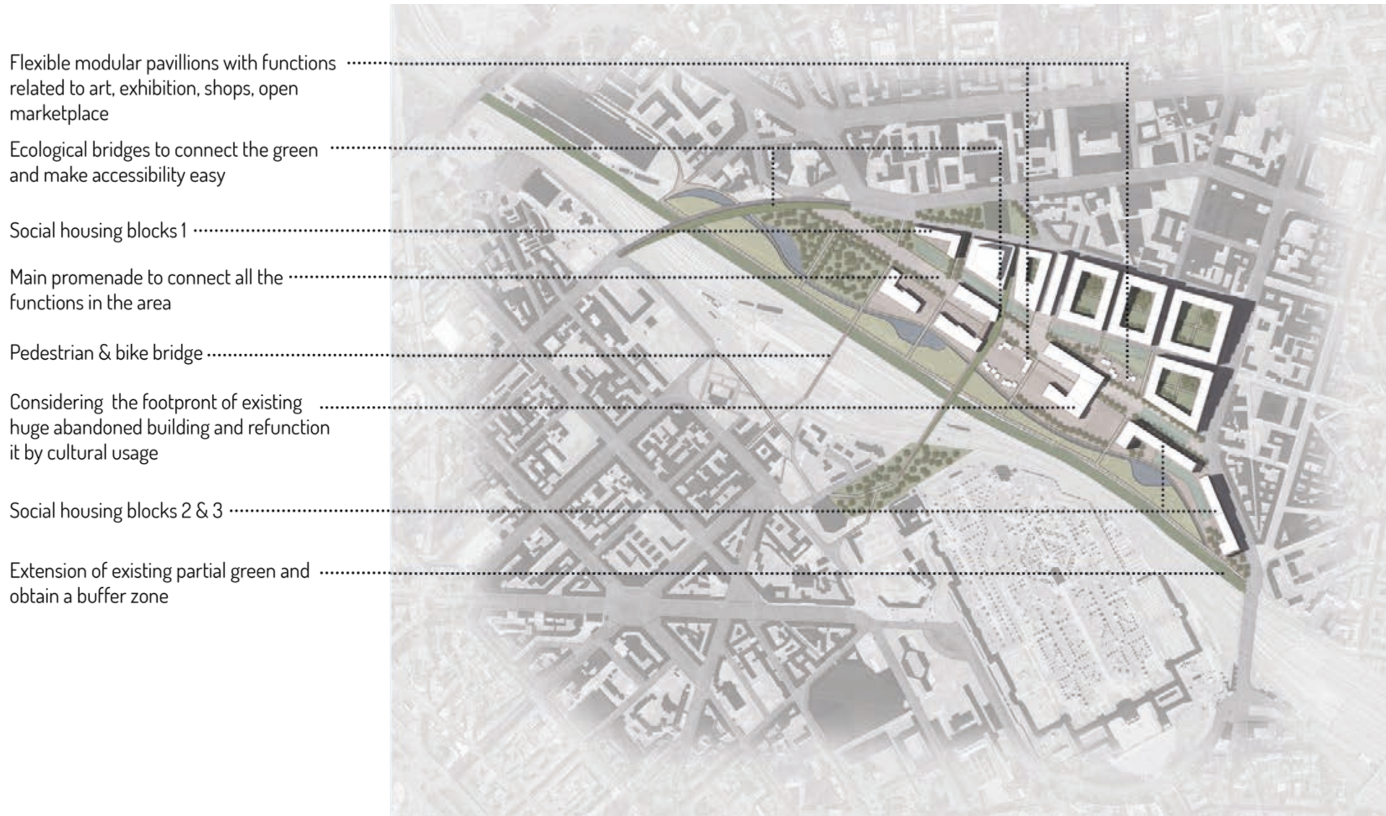
6. Promote walkability, cycling and their integration with public transport: This DOP is correlated with SDG target 11.2. Both walkability and cyclability could improve the energy efficiency in the area and correspondingly decrease air pollution. In addition, to encourage people to walk or cycle improve their physical and mental health. Main aim is to take advantage from the existing pedestrian and bike paths and make the area as a part of this network as it is shown in figures 4a and 4b. In this case, bike is proposed as the main transportation mode. Many bike sharing and bike park points are organized to improve the cyclability in the area and surrounding.

10. City in a food producer: The proposal buildings which has residential functions are located at the northeast part of the site. The shape of this volumes lets to have community garden inside. In total, there are four community gardens which could be managed by the residents who live in this area. All these gardens are connected to each other with internal pedestrian and bicycle paths. At a strategic point, that are reachable comfortably from all the residential blocks, an open marketplace is located with flexible outdoor pavilions. These pavilions let people to meet their need without getting in crowded outdoor spaces. In this open market, the residents could sell their crops from the community gardens and the people from surrounding in the city, could shop vegetable, fruits etc. Especially during the COVID-19 pandemic lockdown and self-isolation to consume healthy food and to grow it trustily became common concerns in order to reduce risk immunology system.

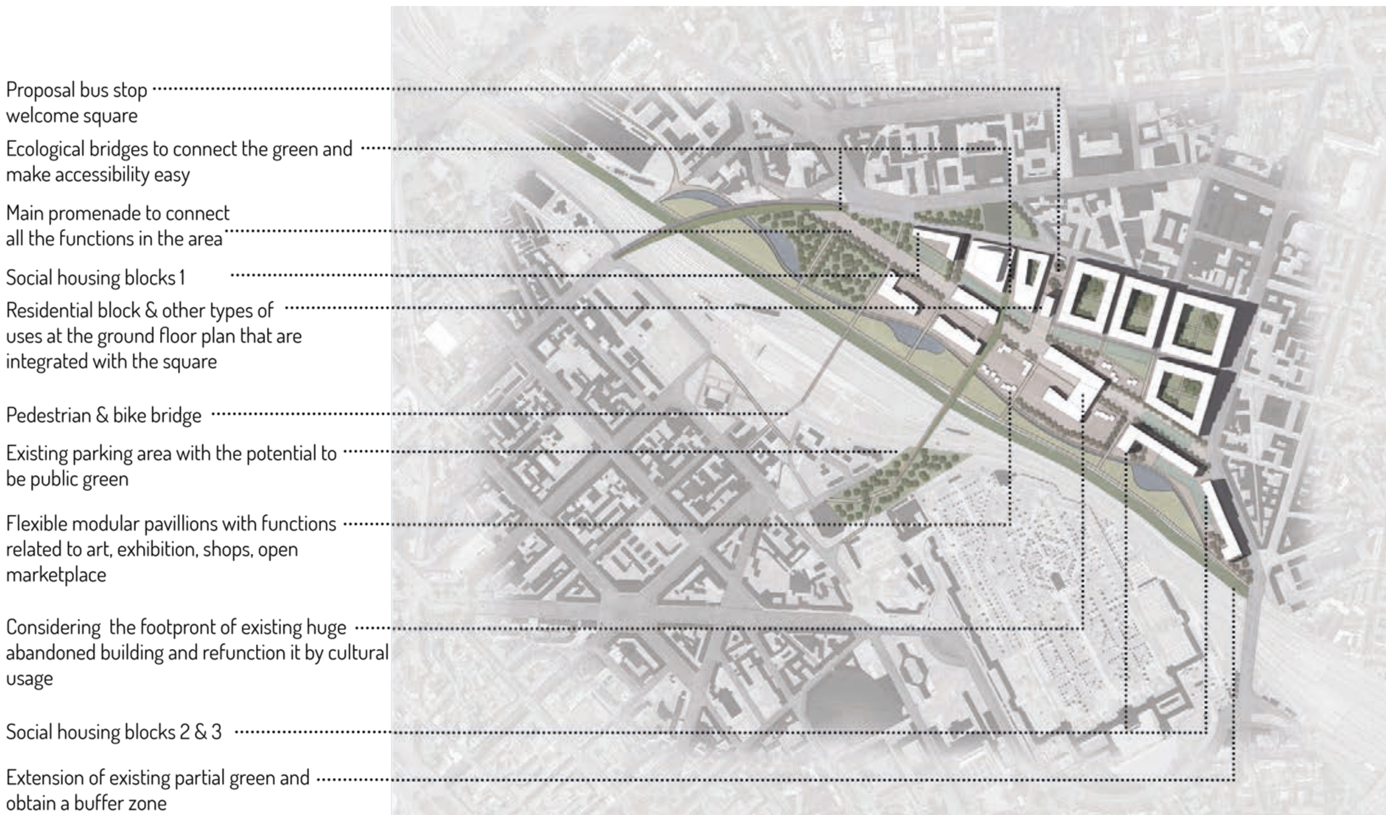
[SCh 5] Table 3. Assessment Metrics of existing situation. Source: author elaboration

	Key Category		Metric	Result
1	Porosity	1	Void Volume Ratio	0,910
		2	Net Floor Ratio	0,772
		3	Net Courts Area Ratio	0,093
2	Permeability	4	Directness	0,821
3	Accessibility	5	Number of Key Functions	0,441
		6	Network Measure	0,558
		7	Attractors	0,574
		8	Generators	0,179
4	Interface	9	Block Built Parameter	0,665
5	Proximity	10	Mixed-use Share	0,548
		11	Surface Share	0,144
		12	Simultaneous Proximity	0,962
		13	Street Discomfort Ratio	0,454
6	Effectiveness	14	Employees Density	0,799
		15	Volume Density	0,463
		16	Population Density	0,970
7	Diversity	17	Number of Types of Uses	0,313
		18	Diversity Index	0,446
		19	Coverage	0,203

[SCh 5] Figure 5. The initial masterplan – Masterplan I. Source:Ogut, 2020



[SCh 5] Figure 6. The final masterplan – Masterplan II. Source: Ogut, 2020



3. Findings

After obtaining the assessment metrics (Table 3) and performance indicators (Table 4) for investigating the existing situation of the area, the masterplan is improved by following the process of IMM methodology, that is illustrated as Masterplan I in figure 5. This masterplan is produced as a part of a master's thesis (Ogut, 2020) in collaboration with IMM Design Lab.
The aforementioned DOPs have been used as guideline in order to develop the masterplan I. This area is going to be a new part of the society and have to meet the requirements of sustainability from environmental, social, and economic aspects.
After the first masterplan, the diagnostic process has redone, and some parts detected as under-performed. Because of this reason, it is efficient to go back to the transformation phase and proposed some local interventions in the masterplan which is shown as Masterplan II in figure 6.
Both after producing masterplan I and II, the performance indicators have been recalculated to evident the improvement, as the result can be seen in Table 4. In case of opposite situation and/or less improvement than required, masterplan is partially edited.

[SCh 5] Table 4. Performance Indicators of existing situation and after two masterplans. Source: author elaboration

DOP		Indicators	Existing	After Masterplan I	Change I	After Masterplan II	Change II
1	1	SDG 11.3.1 Ratio of land consumption rate to population growth rate	32,33	29,24	3,09	29,24	3,09
	2	SDG 11.1.1 Proportion of urban population living in slums, informal settlements, or inadequate housing	17,27 (ISTAT, 2019)	17,1	0,17	17,1	0,17
	3	Number of buildings per hectare	11,1	11,58	0,48	11,56	0,46
	4	Urban Built density	2,29	2,33	0,04	2,33	0,04
	5	Block Density	0,51	0,52	0,01	0,52	0,01
2	6	Heatmap Street indicator	0,054	0,058	0,004	0,058	0,004
3	7	Ratio between numbers of residents and activities	139,77	138,88	-0,89	138,72	-1,05
	8	Housing diversity	0,115	0,117	0,002	0,117	0,002
4	9	Proportion of the resident living 300m of a park	63%	94%	31%	95%	32%
5	10	Extent and number of parks (%)	5,39%	7,30%	1,91%	7,30%	1,91%
	11	Lawn Cover Ratio (LCR) (%)	13,17%	17,30%	4,13%	17,31%	4,14%
	12	Percentage of Residents within Walking Distance of a Recreation Area %	79%	93%	14%	95%	16%
6	13	Length of biking roads	5,8 km	18,9	13,1	19,05	13,25
	14	Number of bike parking spots	13,78	16,26	2,48	17,14	3,36
	15	Bike Sharing	92	123	31	128	36
	16	Population with walkable access to bike trails	44%	70,39%	26,30%	70,39%	26,30%
	17	Number of key functions in a walking distance from residential buildings	247	254	7	254	7
	18	Car free or minimal car traffic streets	78,4 km	90,2	11,8	92,1	13,7
	19	Pedestrian street paths - walkways	35,70%	36,33%	0,63%	36,42%	0,72%
	20	Number of people that are within walking distance of frequent transit stops	45%	48%	3%	48,05%	3,05%
	21	Physically permeable frontage. Number of entrances per 100 meters of block frontage	23,21	23,27	0,06%	23,27	0,06%
	22	Sidewalks that are lined with continuous ground-floor activity	4,40%	4,70%	0,30%	4,82%	0,42%
	23	Shade and shelter	4,36%	6,20%	1,90%	6,21%	1,91%
	24	PM10 Annual average concentration in Milan	40 µg/m3 (ISTAT, 2019)	20	-20	20	-20
	25	PM2.5 Annual average concentration in Milan	29 µg/m3 (ISTAT, 2019)	10	-19	10	-19
	26	NO2 Annual average concentration in case	58 µg/m3 (ARPA, 2020)	40	-18	40	-18
10	27	Number of Urban farms within a given locale/ community	3	7	4	7	4
	28	Access to community gardens	5,07%	10,30%	5,23%	11,10%	6,03%

4. Discussion

The assessment metrics are feasible in any case in any city worldwide in case the dataset is available or possible to produce. To apply this kind of objective measurement before design benefits understanding the existing structure of parameters in the context of improving the cities' health and resilience with the lessons learned from the COVID-19 pandemic. There are different questions emerged since the beginning.

The main ones are how urban design is effective on public health and how to rethink how the urban areas are designed, built, maintained, and lived in to minimize the health risks for the long term.

Regarding the first question, it has been known that urban design and urban planning impact meteorological conditions such as temperature and wind conditions due to land use, allowed built volume amount. On a broader scale, wrong policies and implementation can accelerate the climate change effects, and correspondingly it causes an environment that endangers public health. Among the indicators from Table 2, the following ones offer the opportunity to measure these issues: Number of buildings per hectare, Urban Built density, Block Density, Heatmap Street indicator, Housing diversity, Shade, and shelter. Eventually, after the design, recalculating the same indicators shows the optimum option in order to mitigate or even prevent the possible risk factors caused by related urban parameters.

Air pollution is one of the main topics occurred as more noticeable with the COVID-19 pandemic. However, even before the COVID-19, it was evident that there is an undeniable link between human health and air pollution. Respiratory infections, cardiovascular, lung diseases, brain growth damage, the onset of diabetes, and premature mortality are some of the examples. There are three different determined association between air pollution and the spread of diseases: long-run exposure is linked to air pollution (Analitis et al, 2006; Chakrabarty et al, 2021), short-term exposure (Ciencewicki and Jaspers, 2007) and higher levels of air pollution increase the infection because the virus remains in the polluted air longer (Cui et al, 2003; Wu et al, 2020).
The following indicators helps to understand where the project area stands in terms of air quality: PM10 Annual average concentration, PM2.5 Annual average concentration and NO2 Annual average concentration. With proper implementations, the following indicators also help to mitigate this crucial problem: Length of biking roads, Number of bike parking spots, Bike Sharing and Car free or minimal car traffic streets, Pedestrian Street paths – walkways. These are useful to measure walkability and cyclability, which are healthier and more environment friendly options for urban areas than public transportation.

In addition to respiratory, cardiovascular, and many other acute and chronic diseases, physical and mental health could be threatened in urban areas. Accessibility to open green and public areas has a positive impact on the physical and mental health of the public as well as improving environmental quality by cleaning the air. The decentralized network of smaller green spaces will make it easier for residents to breathe nature that has important physical and mental health benefits (Velarde et al, 2007). Extent and number of parks (%), Lawn Cover Ratio (LCR) (%) are the indicators to represent these aspects.

Food is now produced through vast spanning networks that are vulnerable at many points and function as effective disease vectors (Matthew and McDonald, 2006). Besides, public have more awareness of the importance of immunology system, hence they are more conscious about what they eat, and tend to consume food from the sources they rely on or even they produced themselves. To measure access to community gardens, Number of Urban farms within a given locale/community are initiatives to include this issue to urban design and health relation from another perspective.
The Proportion of urban population living in slums, informal settlements or inadequate housing, Ratio between numbers of residents and activities, Percentage of Residents within Walking Distance of a Recreation Area %, Population with walkable access to bike trails are the indicators proposed to evaluate the effect of demographic factors on the contagion risks in an integrated way to urban related featured.

5. Conclusion

An urban area is like a living organism, in other words, it has a dynamic structure. 19 metrics among 42 and 28 performance indicators among 150 of IMM have been selected and applied to an urban area in Milan in order to assess the conditions created by urban morphology and affected the public health. 7 Design Ordering Principles among 12 of IMM, have been taken account as guidelines to improve these conditions in the transformation process of the case into more resilient and healthier area to live in. All the issues have an interrelated effect sequence. Some of the DOPs has direct impact on health. 3 DOPs among the 7 selected ones have direct impact. Although keeping the social distance, wearing mask, and being vaccinated might be effective for protection from the COVID-19, this pandemic is not only a health problem. It is a wicked problem since the nature of transmission is not easily definable and the state continues to change over time.

Therefore, the city has to be considered from a holistic point of view. Urban morphology is not just transportation or energy performance from environmental point of view. Every aspect is related to each other as a ring of a chain. Besides environmental issues, economic and social perspectives have to be included in urban design, regulations, and planning. Sustainable Development Goals provide an effective framework to achieve this, however they have to be interpreted as a network.

As mentioned before, the goal 11 is Sustainable Cities and Communities, directly related to architecture and urbanism. Nevertheless the goals 2 (food security and nutrition and sustainable agriculture), 3 (Good Health and Well-being), 6 (Clean Water and Sanitation), 7 (Affordable and Clean Energy), and 13 (Climate Action) should not be forgotten in whole process of policy making, design, and application in all scales.

Despite growing research, there are still questions without certain answers about the spread of the virus. Due to the fact that the pandemic is still going on to be a threat, a new paradigm is necessary. This new paradigm is going to affect the way of design. For instance, the trends of transportation have been changing and the relevant Design Ordering Principles seems a few. However, this change has to be thought simultaneously by considering the other Design Ordering Principles that are focusing on different subjects but pertaining to each of them. During the pandemic, the role of green infrastructure in built environment is attracted more attention. Increasing the open green amount is crucial because of many benefits such as improving air quality, enhancing biodiversity, managing exceed stormwater, and supplying food.

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