Walkability City Tool (WCT): measuring walkability

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Abstract

Public space is the essence of the city but almost 70% of this public space is occupied by surfaces meant for cars. And yet citizens who walk are the ones who give meaning to this public space. The habit of walking benefits both the individual and the community to which they belong, both of which are widely documented. The needs of the roadway networks have been repeatedly analyzed but, what about the pedestrian network? Prints of the streets that work the best or worst are often examined without analyzing pedestrians' reasons for choosing different streets to walk on. Likewise, interventions on the pedestrian network are not made using clear criteria. There is a significant body of scholarly work that has researched this topic, with prominent figures in urban planning (Jane Jacobs, Jan Gehl...), sustainable urban planning certification systems (BREEAM, LEED, CASBEE) and even indexes that work on some of the factors that influence walkability (PERS, WalkScore...). The development of WalkabilityCityTool emerged in response to the needs detected stemming from the lack of compiled, precise, objective information on the walkable network when taking strategic decisions on the city that affect pedestrian mobility (and its influence on the model of city, retail, tourism...). WCT examines the factors studied via five topics: Modal Distribution: division of space between the different means of transportation (number of lanes, parking, public transportation...); Urban Grid: characteristics of the sidewalks (width, condition of pavements, obstacles...); Urban Scene: information on the environment around us as we walk (activities on street level, trees...); Safety: perception of safety when walking (street lighting, presence of people...) and Environment: factors that influence walkers (noise level, pollution...). The methodology of the tool starts with gathering a wide range of information on the street from each of the sidewalks and intersections (accessibility, danger...) in order to get a geo-referenced weighted WCTscore, yielding a walkability "heat map" that allows city managers to draw from extraordinarily valuable analytical information. Application: One of the most recent applications of the WCT was in the financial district in Panama as part of the Emerging and Sustainable Cities Initiative (IDB). Using the WTC allowed the city managers to have precise, objective information on the state of the network of sidewalks and intersections in one of the city's most centrally-located, emblematic neighborhoods in order to make decisions and establish priorities on the investments to be made. Conclusions: Current mobility policies are encouraging citizens to use their private vehicles less, restricting access and lowering the amount of surface area devoted to vehicle circulation and parking. However, pedestrian spaces should not be characterized solely by the absence of cars, since there is a host of factors that affect their quality and make them true public spaces in the broadest sense of the term. The application of WCT helps the pedestrian network to be regarded not only as a leftover from the roadway network but more as a grid in itself which should be improved in order to support modal change policies towards non-motorized means.

Keywords: pedestrian network, sidewalks, pedestrians, analysis, Geographic Information Systems.

1. Introduction

1.1 Cities and public space

Today the physical city where we interact is made up of our squares, parks and streets: public space is the essence of the city. Almost 70% of this public space is occupied by surfaces that

serve cars. But walking citizens are the ones who give meaning to public space, where they walk, look, interact, shop, meet, have fun, rest, travel, work… they perform an endless series of activities that should be encouraged by providing them with appropriate spaces.

1.2 Cities and mobility

The design of our cities and the steady increase in the number of inhabitants means an increase in the use of private vehicles, leading to the usual congestion of the streets. Zoning, low intensities, poor strategic design and poorly planned public transportation are just some of the factors that contribute to aggravating these mobility problems within the city and everything they entail.

1.3 Why encourage walkability?

Cities should work on measures that encourage modal shift to non-motorized means and collective transportation. The fact that walking should bring benefits to both the individual and community in which they live is both well-grounded and amply documented.

1.4 Why analyze walkability?

The needs of vehicle roadways have been extensively analyzed: the number of vehicles circulating on the street are tallied, wait times at traffic are studied, the traffic situation is reported, work is done on lane width and speeds, etc. This allows us to evaluate the road network and act on the points where it is most needed in the most appropriate way.

But what about the pedestrian network? It is often dealt with using impressions on which streets work better or worse without analyzing the reasons pedestrians choose one street over another. The interventions, such as the creation of pedestrian zones, ramps, parking, etc., are not performed with clear criteria.

In recent years, a great deal of effort has been invested in the quality of the urban space and walkability, or how friendly an area is to walking. Numerous factors come into play in the experiences of citizens who walk around the city.

1.5 Current state of the technique in this field

Below is a description of the current state of the technique from three of its vantage points:

1.5.1 Development of scholarly research

As a landmark figure in the shift in how we view cities, particularly from the standpoint of the pedestrian, we should cite Jane Jacobs (1916-2006), a popular Canadian scientist, urban planning theoretician and socio-political activist who was born in the United States. Her most influential work was “The Death and Life of Great American Cities” (Jane Jacobs, 1961). Contrary to the schematic city models that lead to the destruction of public space and communities, she asserts that dense neighborhoods and mixed uses make for vibrant places to live and work.

In his work “Tivoli Gardens” (John Lyle, 1969), John Lyle analyzes which benches are used the most on paths. Subsequent studies have further plumbed this kind of issue, such as “Seating Preferences on Kongens Nytorv” (Louise Kao, 1968), “Pedestrians” (Jan Gehl, 1968) and “The

Livable Environment: Psychological Aspects of Homes" (Jan Gehl, 1971a).

In his book "Life between Buildings" (Jan Gehl, 1971b), Jan Gehl introduces the relationships between the shape of the urban space and social behavior.

These authors cited have transformed our way of understanding urban space in relation to citizens, but there is a host of scholarly studies that analyze how the characteristics of the urban space influence the people who walk there. Many of these studies come from the world of medicine, regarding the health benefits of walking. Others relate the price of housing and therefore quality of life with an area's ease of walking.

1.5.2 Vision of sustainability certification systems

Currently, the most influential sustainable urban planning certification systems are BREEAM, LEED and CASBEE.

BREEAM (Building Research Establishment Environmental Assessment Methodology) was conceived in the United Kingdom in 1990. There are different schemes of BREEAM certification; BREEAM Communities is the one applied in urban planning.

BREEAM assesses factors like accessibility, the distance to green areas, the design of safe spaces (in terms of the characteristics of the building facades, lighting, the existence of furniture, etc.), whether façade design encourages street activity (number of shops, number of gaps, blind zones, etc.).

LEED (Leadership in Energy & Environmental Design) is a certification system developed by the U.S. Green Building Council in 1998, in which projects earn points for meeting specific criteria. There are different kinds of LEED certification; LEED for Neighborhood Development is the one applied in urban planning.

LEED assesses factors that directly affect walkability, such as sidewalk width, building facades (number of entrances, glassed-in areas, etc.), the accessibility of parks, recreational facilities, etc.

CASBEE (Comprehensive Assessment System for Built Environment Efficiency) is a Japanese certification system that started being developed in 2001. A variety of different tools have been developed; CASBEE for Cities and CASBEE for Urban Development are the ones applied in urban planning.

CASBEE assesses what it calls social aspects such as traffic safety and crime safety, environmental quality aspects like shade and universal accessibility, and other factors.

In Spain, Salvador Rueda from the Urban Ecology Agency of Barcelona has developed a system of sustainability indicators which evaluates the degree of city model fit both at the start of the urban development (planning) and once the action has been implemented and is running (use and management) (Certification of Ecological Urban Development, Urban Ecology Agency of Barcelona, 2014). It studies factors related to the quality of urban space within the following areas:

- Public space and livability. Accessibility of the public pedestrian routes, air quality, acoustic comfort, thermal comfort, spatial perception of urban green.

- Mobility and services. Proximity to transportation networks other than cars, proximity to bicycle parking, proximity to bicycle loan service, parking, loading and unloading.

- Urban complexity. Balance between business activities and residences, local activities, knowledge-dense activities.

- Green spaces and biodiversity. Functionality index of parks and gardens, tree density per roadway, diversity of urban trees.

- Social cohesion. Availability of facilities.

1.5.3 Existing tools that work on walkability

The research performed analyzes the factors and features of other tools that deal with walkability, such as WalkScore, Walkonomics, PERS, MAPS, PEDS, SPACES and IAAPE. In each case we studied their sources, factors and objectives in order to discriminate and choose the most valid, least subjective ones with the greatest influence on walkability and less complex to obtain.

2. Methods

Walkability City Tool was developed in line with the preceding research. It is an analysis methodology based on Geographic Information Systems that allows the walkable network to be customized and measured, including technical, environmental, social, tourist and economic factors, in order to analyze, interpret and plan improvements in them. It can be used to support strategic decisions on the city based on evidence instead of on intuitions and subjective opinions.

2.1 How does the Walkability City Tool analyze walkability?

The factors that most significantly influence walkability have been gathered, culled and studied. The working base of the data-gathering with the WCT is the sidewalk, the place where people walk, and not streets or roads. They are grouped into five thematic areas:

- Modal distribution. Figures on the division of space between the different means of transportation: number of lanes, parking lots, bicycle lanes, pedestrian zones, public transportation, etc.

- Urban grid. Characteristics of the sidewalks: width, pavement condition, protective strip, obstacles, intrusions, slope, etc.

- Urban scene. Figures on the environment around the pedestrian when walking: activities, homes, trees, characteristics of the façades, urban furniture, etc.

- Safety. Factors that influence the perception of safety when walking: street lighting, direction signs, presence of activities, etc.

- Environment. Environmental factors that influence the activity of walking: noise levels, sunlight, pollution, dominant winds, etc.

Crosswalks are analyzed from three perspectives: delay (time it takes to cross them), safety and accessibility.

2.2 Methodology

2.2.1 Data-gathering

2.2.1.1 City and experts

The first information-gathering phase comes from studying the city and the working area with the help of experts in different fields who are familiar with the city, including planning, mobility, education, safety, governance, a range of associations, existing working groups, etc.

2.2.1.2 Citizen participation

A participation strategy is devised to gather information from citizens who live or perform some kind of activity in the area being studied. Depending on the kind of population sample, open information-gathering sessions are organized, some of whose results are later used to prioritize the actions.

2.2.1.3 Field data

The exhaustive gathering of the information needed on the sidewalks, the overall setting and crosswalks takes place on the street. The way the information is gathered is determined based on the scope of the project, although it usually happens by training auditors or in-house staff.

2.2.2 Data analysis

By weighing the data, a score is assigned to each stretch of the sidewalk and each crosswalk indicating their degree of walkability.

The data gathered and the scores are fed into a Geographic Information System. The WCT tool is completed with the Massachusetts Institute of Technology's "Urban Network Analysis" freeware, applying its calculations to flows among nodes.

The data obtained is used to create graphic information that is easily interpretable by managers: "heat" maps assessing the streets, dysfunctions in the network, black spots, repercussions of actions, etc.

3. Results

As part of the Emerging and Sustainable Cities Initiative of the Inter-American Development Bank, Walkability City Tool has been applied in the Financial District of Panama City (Figure 1).

Figure 1. Area of study in Panama City.

A walk through the district reveals that there is much room for improvement on the streets: the sidewalks are invaded by cars and even disappear, and there are obstacles, holes, steps, etc. Efforts are needed to design the pedestrian service, protect against vehicles and improve crosswalks, but it is imperative to be able to see all of these deficiencies in an objective way.

When applying the methodology described above, in the first phase information was gathered from the local authorities and experts: the mayoral team, the urban planning team, the team from the Inter-American Development Bank, neighborhood representatives, wheelchair users, etc.

The second phase involves citizen participation, in which people of different ages and conditions discuss the factors that influence them the most when walking.

Finally, the fieldwork is performed, led by the city's urban planning team. The auditors receive training which enables them to gather the data, specifically 42 items on each sidewalk and 13 items on each crosswalk.

Once all of the data have been fed into the WCT tool, the results enable us to develop an analysis and diagnosis of the walkability of the zone. The average score of the area (Figure 2) gives an idea of its degree of walkability. Furthermore, each stretch of sidewalk and each crosswalk can be analyzed through their overall WCT Score (Figure 3) or thematically.

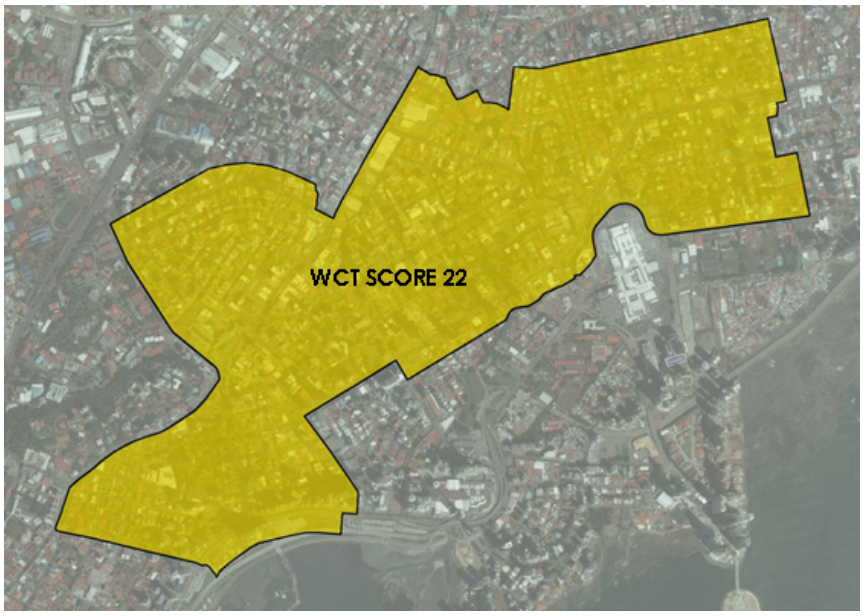

Figure 2. Average WCT Score of the area of study.

Figure 3. WCT Score on stretches of sidewalk.

The average score per zone (Figure 4) allows us to compare the different walkability conditions in each neighborhood.

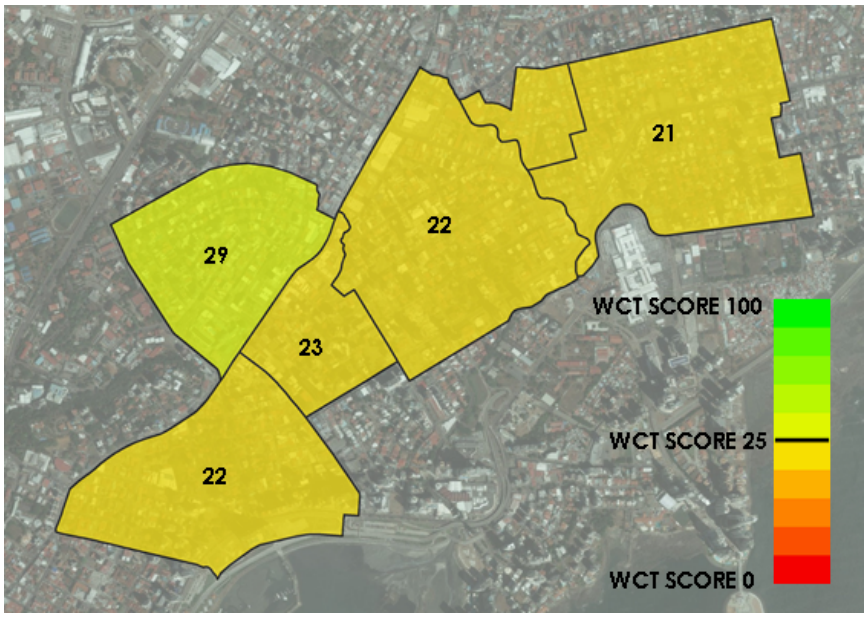

Figure 4. Average WCT Score per neighborhood.

The picture reflects the walkability of the streets projected over the area (Figure 5), revealing the focal points of positive influence, such as parks and the more walkable streets, compared to the zones with the most dire shortcomings.

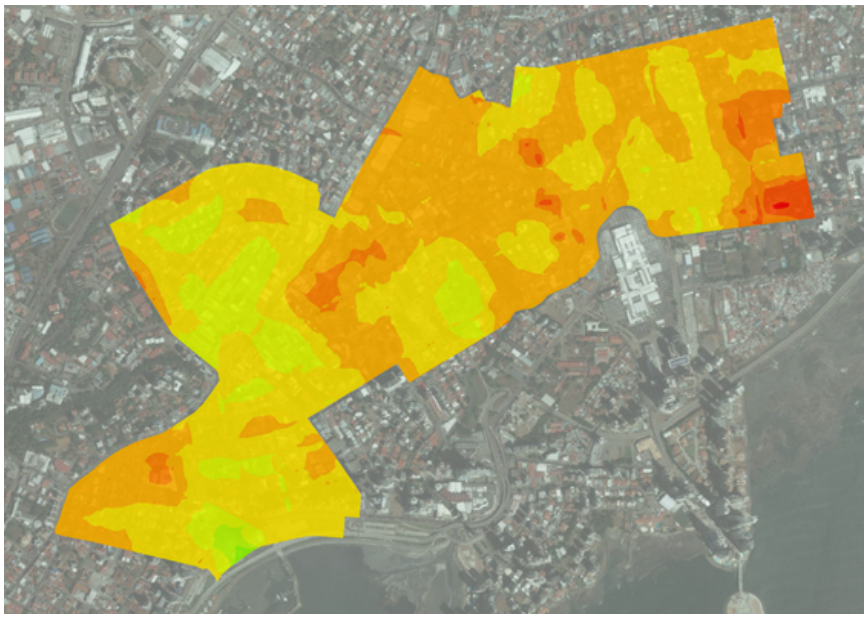

Figure 5. WCT Score in área.

In addition to the analysis from the map with the overall scores of each stretch of sidewalk, studying the different thematic areas separately or even certain particular items by neighborhood (Figure 6) allows us to determine the priority strategies of action.

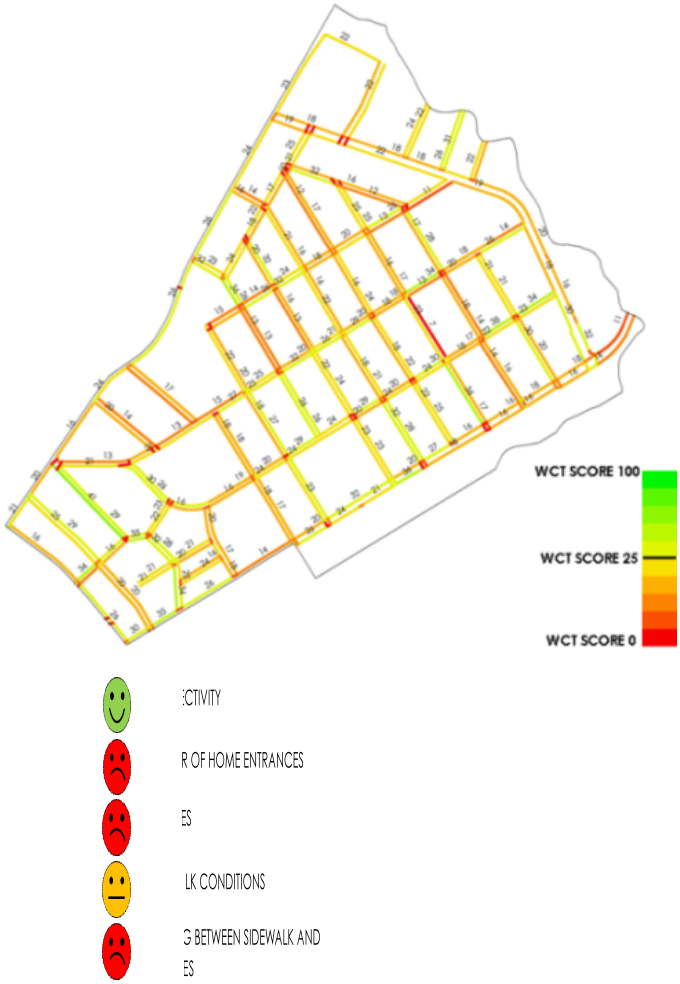

Figure 6. Example of neighborhood analysis.

All the subway stations and their coverage are also analyzed (Figure 7). The roadway network surrounding the subway stations, with their sidewalks and crosswalks, is what provides the pedestrian coverage needed to allow the public transportation network to be used to its fullest. Improvements in the walkable network near the stations will lead to an improvement in their accessibility and a consequent increase in the number of users. Two stations are located within the area of study, situated with a service radius of between 400 and 500 meters (approximately a 5-minute walk). However, this is a theoretical radius which could be transformed into real distances if routes are taken along sidewalks and crosswalks. Thus, these 400 meters considered suitable for the station service are reduced considerably in some areas due to the morphology of the urban fabric, such as large city blocks, few crosswalks, etc. (Figure 8).

Figure 7. Theoretical radial coverage of the stations.

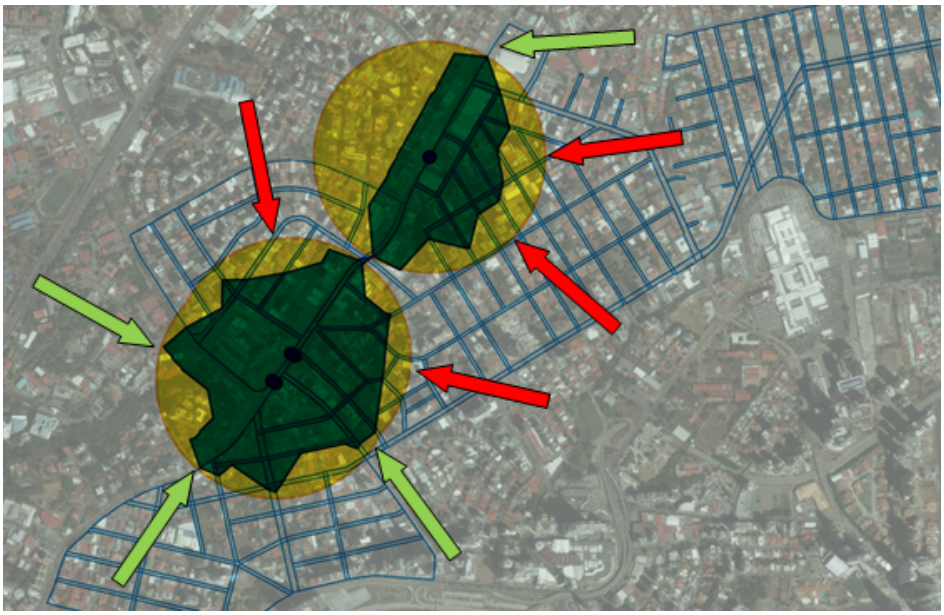

Figure 8. Coverage by sidewalks and crosswalks.

If we further this analysis with the influence of the characteristics of the streets when walking (WCT Score), we can see how the theoretical distance of 400 meters contracts when the scores are low and expands when they are high (Figure 9). This reflects the fact that people are willing to walk more on some streets than others. A superimposition of the study of this coverage with the theoretical initial radius of 400 meters reveals that in some cases the characteristics of the streets are effectively shrinking the area covered by the infrastructure (Figure 10).

Figure 9. Coverage with WCT Score.

Figure 10. Comparison of coverages.

A sound strategy to foster and support the use of the subway network is working on the factors that affect the walkability of the areas around the stations. Some of the factors are quicker and easier to improve than others, and some are the outcome of others and happen naturally over time.

4. Discussion

The WCT tool groups together and weighs the factors that affect walkability by assigning values to the network of sidewalks and crosswalks. Thus, the areas can be analyzed by both the overall value of the streets and the partial scores by areas (Modal Distribution, Urban Grid, Urban Scene, Safety and Environment) and, of course, by viewing the maps of each of the items covered. Just like any database, it has to be consistently updated so that the city managers can have a clear picture of the situation of the streets, establish priorities and intervention strategies and manage the available resources, aimed at investments that seek clear objectives instead of merely

generating maintenance costs.

5. Conclusions

In order to ensure that pedestrian mobility is borne in mind at the same level as vehicle mobility in mobility policies and plans, it is essential to have objective data. Walkability City Tool captures 55 main parameters of the pedestrian network (sidewalks and crosswalks) which are weighed to yield a walkability index. Feeding the information into a GIS allows the network as a whole to be analyzed, as well as each element independently, and it also allows routes to be calculated. The tool can be applied in countless ways: making strategic decisions on the city, developing specific indicators to monitor its evolution, laying out specific routes for groups (walks to school, tourism, the disabled), comparing grids, the influence of the walkable network on actions on the urban grid, etc.

Walkability City Tool is therefore a powerful analytical tool for sustainable urban management:

- Environmental sustainability, since intelligently managing mobility based on an analysis of the pedestrian network allows decisions to be made aimed at encouraging less-polluting means of transportation in order to lower emissions, noise, congestion and accidents and improve air quality, acoustic quality and citizen health.
- Economic sustainability, since establishing and monitoring parameters and indicators on urban pedestrian activity allows actions to be planned and prioritized, transforming spending into investment. Furthermore, the tool also provides data to help take strategic decisions on retail and tourism, the economic engines of many of our cities. Indirectly, the environmental and social improvements also translate into economic savings for citizens (for example, less pollution and improvements in healthy living habits lead to lower healthcare spending).
- Social sustainability, since the main goal of intelligently managing the city is to improve its inhabitants' quality of life. The Walkability City Tool allows factors to be identified that can lower social exclusion, foster integration, improve social relations and quality of life in the city and minimize conflictive spots. Furthermore, the improved quality of our public spaces and their transformation to the scale of citizen on the street improves social relations and life in the city.

Analyzing each street and each crosswalk allows us to study urban grids as a whole in the quest for a model that increases complexity, cohesion, compactness, information and knowledge so the compact, diverse city head towards sustainability and the Smart City.

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