Research Paper

Walking as a vector of urban and landscape requalification, focused on the perception of lived spaces

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ABSTRACT:

Nowadays, many cities around the world are suffering from the growth of automobile mobility, this has brought many problems, such as air pollution and the increase in obesity and related diseases (WHO). Urgent scientific answers are needed, and researchers are increasingly interested in the study of soft mobility by trying to understand the factors that need to be analyzed and to find the most appropriate methods to ensure sustainable mobility in urban spaces. This present research essentially aims to understand the concept of walkability, then to determine the role of the elements of the urban environment in the improvement of urban walking, by studying the way in which these influence the perception and affect the behavior of users and their ways of getting around town. It is particularly a question of determining how to encourage walking in an urban environment by acting on this type of element. The verification is carried out using representative field samples, selected mainly from the urban fabric of the hyper-center of the city of Bejaia (Algeria).

Keywords:

mobility, walkability, pedestrians, hypercentrality zone, pedestrian potential

1. Introduction:

The growing motorization of our societies has been an undeniable fact since at least the middle of the 20th century. Geographically, this phenomenon has been all the more noticeable in recent decades that there was a real or supposed development lag compared to the Western hegemonic model (Webber, 1996; Pope, 1996; Mangin, 2004; Grosjean, 2010). In parallel with this phenomenon of motorization, the World Health Organization (WHO) states that diseases linked to stress, obesity and lack of physical activity have increased significantly in recent decades, especially among young people and the elderly. To remedy this worrying situation, the WHO suggests the promotion of active mobility, making substantial use of the muscular energy of the human body.

Faced with such a finding, we are witnessing an unprecedented acceleration of research on soft modes of transport, in particular pedestrian mobility. Through this research, walking has often been associated with many benefits, ranging from preserving the environment through reduced pollution, smoother traffic, to solving obesity and other health problems (Kayser, 2008). Moreover, it also represents an essential element in the creation of “liveable communities”, allowing the weaving of social ties and encounters and making the urban environment a more pleasant place to live (Emery and Crump, 2003).

And following the Covid 19 pandemic, by seeking alternatives to reduce the spread of the virus and protect the health of users, walking has become a good mobility solution, capable of ensuring "distancing social”.

As such, walking can be considered one of the "winners" of the health crisis. With all of these benefits, one of the hardest problems to solve is how to motivate people to walk.

Walkability has recently been introduced as a concept that reflects the extent to which the urban environment is pedestrian-friendly (Abley and Turner 2011). Planners may be able to assess the quality of the built environment by measuring its walkability. Urban morphology, moreover, qualifies and connects all the physical characteristics of the built environment, at the same time at the architectural scale, of the urban fabric and of the landscape. It cannot be dissociated from the reasons (historical, philosophical, political, social and technical) for the formation and transformation of the urban form, as well as the cultural values and different meanings it carries. (Kropf, 2009). The study and research on walkability correlated with morphology, sociability and perceptions, concerns many researchers today. However, the consensus inherent in the process and the content to be measured is still not yet established and remains a subject for debate, due to the wide range of parameters that could disadvantage or encourage walking. We have therefore devoted our present investigation to an analytical assessment of the degree of walkability within urban centers, with the aim of highlighting the determining criteria for the promotion of walkability.

The Algerian city of Béjaïa, like other North African cities, is not immune to problems related to the "everything by car" policy, it is highly exposed to the fallout from the excessive use of transport, especially in its hypercentral area. Considered as the most important mixed zone in the city, it is the part of the city most suitable for the possible promotion of pedestrian mobility. We should therefore know if it is possible to qualify this area of urban hypercentrality of the city of Bejaia as being a walkable entity. To do so, we need to answer the following question: **to what extent can we judge the quality of walkability in this study area, in order to be able to recommend the measures necessary for its optimization?**

This work is the subject of an exploration of the concept of walkability and its semantic field, the dimensions and factors influencing the degree of walkability studied by researchers, as well as the different measurement methods. The conceptualization resulting from the investigation carried out will be applied to our chosen case study (Bejaia) in order to answer the various questions raised.

2. LITERATURE REVIEW:

Walkability has been defined as the extent to which features of the built environment and land use may or may not be conducive to area residents moving for entertainment, exercise, or functional need. (Leslie et al., 2007). Bradshaw (1993) defines walkability as a “quality of place” with four characteristics: An easy-to-use, man-made physical microenvironment (wide sidewalks, small intersections, narrow streets, lots of vegetation, good lighting and no obstacles); A full range of useful destinations within walking distance (shops, services, employment, professional offices, leisure, libraries, etc.); A natural environment that moderates extreme weather conditions (wind, rain, sunlight, while providing cooling and freedom from human overexploitation, freedom from excessive noise, air pollution, or dirt, stains and grime from car traffic); A local, social and diverse culture (easy contact between people and social and economic links). Abley, Turner and Singh (2011) define walkability as the degree to which the built environment is conducive to walking. Transport for London (COST 358, 2010) has also addressed this issue, categorizing the concerns and needs of pedestrians according to a set of key factors, which represent the seven (07) dimensions of walkability: connectivity, convenience, comfort, usability, readability, coexistence, and interaction.

2.1. Factors influencing the degree of walkability of an environment: Many researchers in the field of soft mobility, landscape, sociology, anthropology, etc., such as Kayser, Handy, Thomas and others, have confirmed walkability is influenced by many important factors. In this part of the theoretical framework, we will focus on presenting the key elements of the literature concerning the links between

walkability and the built environment, ambiances and individual perceptions. We will then discuss the walkability audits most used by researchers.

2.1.1. Walkability and the built environment: According to Kayser (2008), the characteristics of the pedestrian environment have a strong influence on walkability. According to him, walkability defines the adaptation of a built environment to walking. The built environment can be described as the part of the physical environment built by human activity (Saelens and Handy, 2008). A “walkable” environment is a good quality environment, suitable for pedestrian scale, and offers social and leisure functions that encourage walking. The components of the pedestrian environment studied by the researchers and which have a strong influence on the quality of walkability are diverse: The urban form (built environment, circulation, islands, networks, etc.); density and travel distances (the pedestrian travel network in a city must be competitive with other traffic networks; in this sense, it must offer pedestrians the possibility of achieving the same objectives as those proposed by other means of transportation. A sustainable city is built in a dense way which makes it possible to reduce the distances to be traveled by minimizing the use of the private car); the diversity of functions (it makes it possible to increase accessibility and facilitate non-motorized travel by reducing the distance and promotes the liveliness of the streets, thus significantly increasing the level of pedestrian potential (Banister and Hickman, 2007)); permeability, connectivity and accessibility (according to Bentley (1985) are key concepts for the quality of an urban fabric, good permeability should offer pedestrians a variety of routes to get from point A to point B, it essentially depends on the road network, the size of the islands, and the absence of the barrier effect (I. Bentley, 1985). The presence of desire lines indicates a lack of permeability. According to Miserey (Y. Miserey, 2013) accessibility is a key factor in the walkability of an environment, it depends on the comfort and the number of accesses to the space. The degree of pedestrian potential of a space also depends on the connectivity of its streets and the possibility of varying its route: "The freedom offered by walking is precisely that of choosing the route, improvised, diverted or thought out" (Urbaplan, 2007)); visibility and legibility (According to Kevin Lynch, visibility is defined by: boundaries, sectors, nodes, routes and landmarks. Legibility and visibility are two essential parameters for good walkability, they represent the clarity of the landscape allowing the pedestrian to find their way and read the space while creating a mental image of the latter (Lwin and Murayama, 2011)).

2.1.2. Walkability and urban ambiances: Bourdin (2007) defines ambiance as the background of perception, which generates sensations and meanings. Thibaud's work, which is summarized in his book entitled "La marche aux trois personnes, 2008", shows that there are correlations between the concept of walkability and factors related to urban environments. These ambient factors determine the degree of comfort for pedestrians: the noise level, the richness of the sequences, the moving bodies, the vegetation and the landscape qualities, the wind and the quality of the air and the lighting (Thomas, 2005). Thibaud proposes a methodology for the evaluation of urban atmospheres and their influences on walking, it is an in situ analysis, (walking put to the test of the survey), and consists in determining the sensations of pedestrians and their perceptions of the moving environment. To do this, he established a set of distributors, these are the architectural or urban atmospheres that favor or disfavor pedestrian walking: the attractor (promotes walking and attracts the pedestrian), the suspensive (linked to an enchantment , a place, or an event), the distributor (connects the spaces and disperses the pedestrians), the mobilizer (modifies the rhythm of the pedestrian or his trajectory), the accelerator (increases the speed of the pedestrians because of the elements of atmosphere negatives) (Prompt, 2005).

2.1.3. Walkability and individual perceptions: Perception is linked to the feeling of well-being in a space. Walking offers a variety of perceptions and makes it possible to multiply references and points of view by creating different images of space (Thomas, 2007). Arnaud Piombini (A, Piombini, 2006), establishes a certain number of hierarchical needs related to walking where the perception changes according to the

degree of satisfaction of the pedestrian according to: mobility, protection, ease, pleasure and identity. Characteristics that can positively influence pedestrians' perception of their surroundings have been identified by Ewing et al. (2006) in "Identifying and measuring urban design qualities related to walkability", it is about respecting the human scale, transparency, framing, complexity and imageability.

2.1.4. Walkability and sociability: Several researchers around the world are trying to determine if there are links between the built environment and the social character of the inhabitants. Grafmeyer and Authier (2008) emphasize that urban space has a strong impact on people's socialization patterns; these can be seen from the small scale (the house) to the larger scale (neighbourhoods and workplaces). On the other hand, numerous studies prove that the pedestrian potential of an environment and the way in which individuals walk in their neighborhoods is the direct result of the relationships established with these environments. DuToit (2007) states in his study that walking is a key solution for weaving social ties and an essential element for the creation of sustainable communities. This can be enabled by creating meeting areas, opportunities to stop, sit and socialize. Indeed, the street and the sidewalk can host a myriad of human activities that can increase social ties by promoting quality amenities.

2.2. Criteria and methods for evaluating walkability: To measure the degree of walkability of an urban environment, research units around the world and in different fields of knowledge, including transport engineering, urban planning and public health use a variety of methods and techniques. And given the degradation of the pedestrian environment due to the intensive use of the car and the development of transport technologies in recent years, impressive progress has been made in studies measuring walkability. However, a certain number of equations still remain unresolved, namely: a fixing of the scale of analysis, the presence of an excessive number of different evaluation indicators due to the multiplicity of concepts and methodologies of measurement, but also the diversity of the characteristics of urban environments and the dispersion of the origins of the studies carried out (Cambra, 2012). Indeed, this constitutes a major obstacle preventing the creation of a coherent and global analysis model for the measurement of walkability, applicable everywhere throughout the world. Experts (Abley, Turner, Singh, 2011) and (Leslie et al., 2007), emphasized that the built environment should represent the most important dimension for the measurement of walkability, on the other hand, the study of (Owen et al., 2007) takes into account the social and demographic framework (age, sex, etc.) and socio-economic status when measuring walkability. Other researchers have added more specific dimensions, for example, weather conditions (Clark, Scott and Yiannakoulias, 2014) and crime rate (the correlation between personal safety and walking) (Doyle and Kelly-Schwartz, 2006).

2.2.3. Walkability Audits and Indices: A walkability audit is a tool to determine whether or not a neighborhood or location is walkable, based on an examination of various aspects of the physical environment. These audits generally relate to: the combination of urban functions (residential, industrial, etc.), density, street connectivity, road and urban safety, the user-friendliness of urban spaces, landscape aesthetics, etc. These elements differ from one audit to another. These predetermined and validated indicators (qualitative and quantitative data) are grouped together in a grid, and the final result represents the sum of all this information which allows the researcher to come to an objective opinion on the degree of walkability of the studied area (the assets to be value and the problems to be corrected). The walkability audit is often used as a decision support tool for the development of urban centers by public authorities. Some of the best-known audits include: PBIC (Pedestrian Information Center Audit) done as part of the Partnership for a Walking America; WSAF (Walkability Assessment Form) developed by Emery et al (2003) to examine characteristics associated with pedestrian safety; the composite walkability index developed by Park based on 52 walkability indicators taken from the literature; SLU (The Analytical Audit Tool) by (Brownson, RC, Brennan Ramirez, LK, Hoehner, CM, Cook, RA) used to understand correlations between

the street-scale environment and the practice of walking, etc. Krambeck (2006) has a goal of creating a global walkability index.

3. METHODOLOGY AND CASE STUDY:

3.1. The case study: Our choice fell on the district of Lekhmis located in the heart of the hypercentral area of the city of Bejaia (sector 02). The Wilaya[1] of Bejaia is located on the northeast coast of Algeria, at a distance of 240 km from the capital Algiers (figure 01). The city of Bejaïa is the capital of the Wilaya as well as the daïra[2]. The study recently carried out by the design office of the Algiers metro on the feasibility of the future tramway of the city of Bejaia, demonstrated that the hypercentrality zone includes the perimeter of sector 02 which is called " Rue de la Liberté ". This zone of hypercentrality essentially encompasses a significant part of the plain of the city of Bejaia and part of the old city. The district of Lekhmis which is located in the heart of the hypercentre of the city, therefore occupies a significant space in the plain with many functions and activities, it is surrounded by major districts such as the “Arriere Port”, the “City Tobbal”, the historic center of Bejaia ... etc. (Fig. 02). In order to carry out a more precise work on the study of walkability, we have chosen to delimit the study area as much as possible to meet the scale of evaluation (at the scale of the district).

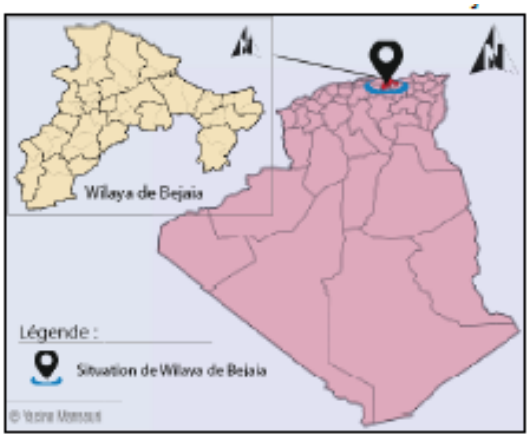

Figure 01: Situation of the wilaya of Bejaia, Authors, 2018

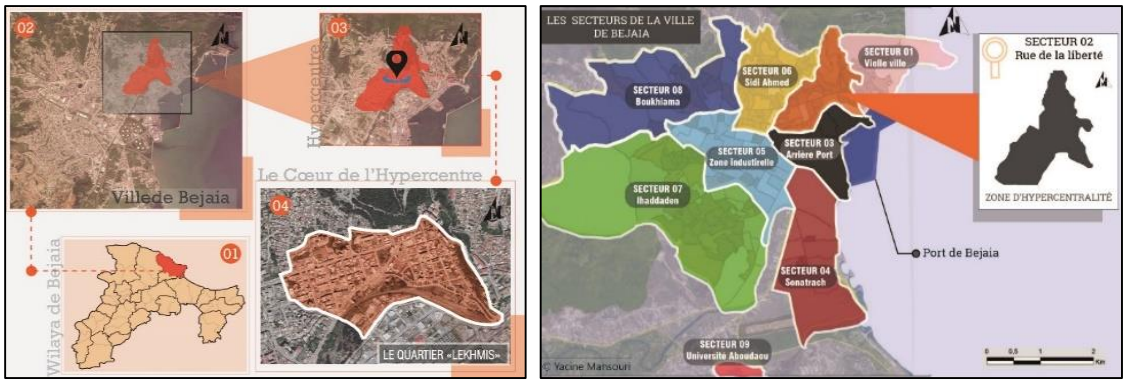

Figure 02: Location of the hypercentre of Bejaia and the Lekhmis district, Authors, 2018

3.2. Research methods: The wide range of research objects that we wanted to examine prompted us to use a myriad of methods to respond to the research problem. For the verification of these indicators, we choose to use different approaches, qualitative and quantitative methods according to the needs and the knowledge sought.

3.2.1. Creation of a walkability audit: To carry out our walkability audit, we used the comparison developed by Clifton et al (2006) to take stock of the elements measured in the most recent audits. Other interesting items that we thought fit to include have been added to the comparison chart. The results of this overlay will then serve as the basis for our audit. The audits compared are as follows:

[1] In Algeria, "Wilaya" represents the territorial division.

[2] In the Algerian territorial administration, the "daïra" is a subdivision of the wilaya.

WSAF[3] (University of North Carolina, Chapel Hill), WPS[4] (Baltimore Metropolitan Council), PIN[5] 3 (Evensen et al, 2009), SLU[6] (University of Saint Louis), PEDS[7] (University of Maryland, College Park.), PBIC[8] (United States Department of Transportation), IM[9] (Irvine and University of Minnesota). The audit constructed consists of 26 indicators organized into seven (7) criteria. For each indicator, a unit of measurement is presented. In order to simplify the study and arrive at precise results when assigning scores, fixed evaluation methods for each indicator are also developed. The indicators are then rated on a scale of three (03) levels. A fully met criterion earns three points (Good), a partially met criterion earns two points (Medium), and an unfulfilled criterion earns zero points (low level). The scores for the indicators are then multiplied by coefficients set in order of priority according to the results of the comparison carried out. The final marks obtained are then combined into a single mark, which is the criterion mark. A final audit score is calculated, which is the sum of all criteria. The use of such a basic scale makes it possible to give all the indicators a common qualitative value based on evaluations of each of them. In order to facilitate the reading of the results, this method is finalized by presenting all the results in graphical form, "radar" style. The audit created is as follows (Table 01):

Criterion	Evaluation indicator	Indicator evaluation method	score	CT	FS	CS
The network	Continuity of pedestrian paths	Strong presence of incomplete paths	**0**	**01**	**06**	**15**
		Average presence of incomplete paths	**1**			
		Minimal presence of incomplete paths	**2**			
		Absence of incomplete paths	**3**			
	Connectivity between sidewalks and with crosswalks	Low connectivity (obstacles, cuts,)	**0**	**02**	**06**	
		Strong connectivity (high number of intersections between paths)	**3**			
	Connection of the district with the city center	Difficulty getting to the neighborhood from the city center	**0**	**01**	**03**	
		Ease of getting to the neighborhood from the city center	**3**			
Permeability	lines of desire	Strong presence of desire lines	**0**	**01**	**03**	**19.5**
		Weak presence of desire lines	**3**			
	Island size (Comparison to ideal size)	Wrong island size (huge islands)	**0**	**02**	**06**	
		Good size of islands (small islands)	**3**			
	The routes	Unsatisfactory choice of routes	**0**	**1.5**	**4.5**	
		Satisfactory choice of routes	**3**			

[3] Walkability Assessment Form
[4] Walkable Places Survey
[5] Neighborhood Audit Instrument
[6] Analytical audit tool
[7] Pedestrian environment data analysis
[8] Partnership for an America on Foot
[9] Irvine Minnesota Inventory

	The barrier effect	Presence of the barrier effect in the neighborhood	**0**	**02**	**06**	
		Absence of the barrier effect in the neighborhood	**3**			
The immediate environment	Imageability	Absence of remarkable architecture	**0**	**01**	**03**	**27**
		Presence of remarkable architecture	**3**			
	Comfort and supervision	Unframed spaces	**0**	**01**	**03**	
		Framed spaces	**3**			
	Lighting*	Lack of lighting	**0**	**02**	**06**	
		Many dark areas cause discomfort	**1**			
		Few dark areas	**2**			
		Omnipresent lighting	**3**			
	Signaling for motorists	Lack of signage	**0**	**02**	**06**	
		Very minimal presence: stop signs	**1**			
		Satisfactory presence (traffic lights)	**2**			
		Excellent presence of measures (signs indicating the presence of pedestrians, awareness, speed bumps.)	**3**			
	Trees/shrubs	Absence of trees or shrubs	**0**	**1.5**	**4.5**	
		Minimal presence of trees or shrubs	**1**			
		Satisfactory presence (we always have an element of vegetation in the angle of view)	**2**			
		The presence is really strong (trees planted every less than 10 meters)	**3**			
	Furniture	Lack of furniture	**0**	**1.5**	**4.5**	
		Minimal presence 1 or 2 over 100m	**1**			
		Satisfying presence	**2**			
		Really strong presence (over 10 over 100m)	**3**			
Accessibility	Urban obstacles	Strong presence of urban obstacles	**0**	**1.5**	**4.5**	**12**
		Average presence of urban obstacles	**1**			
		Low presence of urban obstacles	**2**			
		Absence of urban obstacles	**3**			
	Rest areas	Absence of rest areas	**0**	**01**	**03**	
		Minimal presence (very distant)	**1**			
		Satisfying presence	**2**			
		Really strong presence (in the majority of routes)	**3**			
	relief	Lack of effective facilities (ramp stairs)	**0**	**1.5**	**4.5**	

		Satisfactory presence of efficient facilities	3			
Readability	Pedestrian signage	Insufficient presence of pedestrian signage	0	1.5	4.5	12
		Sufficient presence of pedestrian signage	3			
	Landmark elements	Absence of landmark elements	0	1.5	4.5	
		Minimal presence	1			
		Satisfying presence	2			
		Really strong presence	3			
	Transparency and visibility of human activity	No visibility possible (wall)	0	01	03	
		Minimal visibility (fences)	1			
		Satisfactory visibility (doors, windows)	2			
		High visibility (large windows)	3			
Pedestrian safety	Characteristics of sidewalks and pedestrian paths	Inability to use sidewalks (absent, impassable)	0	02	06	22.5
		Walking difficulties	1			
		Minimal presence of discomfort	2			
		Excellent quality	3			
	Pedestrian crossings	We feel in danger	0	2	06	
		We feel completely safe	3			
	Road traffic calming Vehicle volume (30 seconds)	More than 30 vehicles in a street	0	1.5	4.5	
		16 to 30 vehicles in a street	1			
		1 to 15 vehicles in a street	2			
		Absence or pedestrian zone	3			
	Pedestrian signaling (marked crossings and/or lights intended exclusively for pedestrians)	Lack of signaling for pedestrians	0	02	06	
		Minimal signage (white stripes)	1			
		Good: Traffic light concerning pedestrians	2			
		Very good: Light with countdown/traverse aid island	3			
Sociability and atmospheres	Possibility of stay	Lack of spaces to stay in the neighborhood	0	01	03	12
		Little space allowing the stay in the neighborhood	1			
		Average presence of spaces allowing people to stay in the neighborhood	2			
		Possibility of satisfactory stay in the spaces of the district	3			
	Meeting places	Lack of meeting places	0	1.5	4.5	
		Minimal presence of meeting places	1			
		Average presence of meeting places	2			

		Strong presence of meeting places	**3**			
	Attractiveness of places	Lack of attractive places	**0**	**1.5**	**4.5**	
		Minimal presence of attractive places	**1**			
		Average presence of attractive spaces	**2**			
		Strong presence of attractive places	**3**			

Table 01: the walkability audit – Source: Authors, 2018

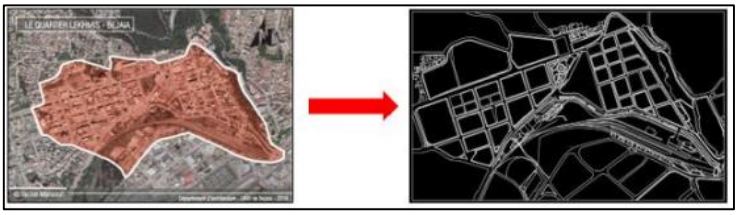

Figure 03: Preparation of DXF file for testing with DEPTHMAP, Authors, 2018

3.2.2. Space syntax: Using the Depthmap software, the "space syntax" method seems to be the best way to measure the visibility and connectivity of urban spaces. The street network of the hypercentre of Bejaia was taken from Google Maps in the form of an updated image, before being digitized in drawing format (DXF) via "AutoCAD 2016" (Figure 03). Then, the data was imported into the Depthmap software and subjected to syntactic simulations. The properties revealed are: integration, choice, connectivity and visibility.

3.2.3. Commented walks: this method consists of combining several key activities at the same time: walking, observing the space, writing, while listening to the walker's words, observing his gestures and trying to decipher his interaction with the space throughout along the journey (Thibaud Jean-Paul, 2001). We involved two main categories of participants, people who already know the city (residents, traders…) and tourists who do not know the city well. Respondents were contacted in advance, and the journeys took place over several weeks and at different times of the day (at different times).

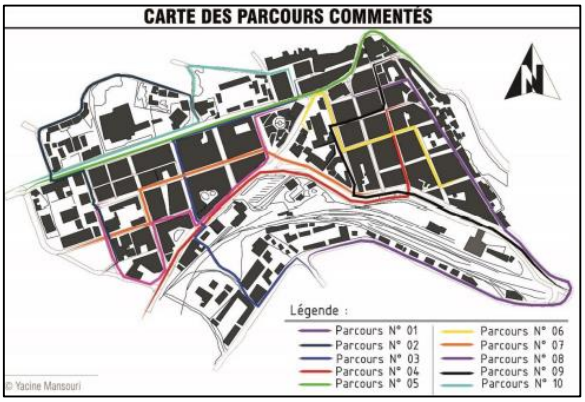

Figure 04: Map of commented routes, Authors, 2018

3.2.4. The questionnaire: in order to verify certain research objects, we used a questionnaire, intended for 50 people. The answers are then combined with the other results.

3.2.5. Direct observation: Using a grid, we use non-participant observation in addition to the study. Photographs and explanations were used to help materialize the data collected. Following the same principle as the commented routes, and in order to obtain more precise results, the observations were made at different times of the day and on different days of the week.

3.2.6. Semi-structured interviews: A meeting was organized with the urban planning department of the municipality, with the aim of obtaining information on the projects in progress in the hypercentre of Bejaia and its surroundings, as well as on their vision of the future of this site and any recommended

operations. The results are presented each time according to the research object studied and each time following the analysis grid.

3.2.7. Cartographic and statistical analysis: All the graphic media used come mainly from the digital map of the city of Bejaia, and updated using Google Maps and Google Earth. The majority of the cartographic and statistical data are drawn mainly from the household travel survey (EMD), and the report of the study on the feasibility of the tramway line in the city of Bejaia.

The methods and research objects are summarized in this analysis grid:

SUMMARY OF RESEARCH OBJECTS AND METHODS USED								
RESEARCH OBJECTS		THE METHODS USED						
		C.R	D.O	C.S.A	S.S.I	WA	S	SS
01		**Understanding of the general context of the scope of intervention**						
Presentation of the scope of intervention				X				
The historical development of the district				X				
The image of the neighborhood in the city		X		X	X		X	
02		**Study of the characteristics of the population in the area of intervention**						
Population growth				X	X			
Population density				X	X			
General household characteristics				X	X			
03		**Study of the characteristics of spatial structure and urban form**						
Travel distances	Functional diversity	X	X	X			X	
	Access to public transport	X	X	X			X	
	The parking	X	X		X		X	
The network	Study of connectivity and continuity	X		X		X		X
	Visibility study					X		X
	Connections with the city	X		X				X
	The road network			X		X		X
Permeability	The urban fabric (The size of the blocks)			X				
	lines of desire	X	X			X	X	
The immediate environment	Comfort and supervision	X	X			X		
	Signaling for motorists	X	X	X	X	X		
	Imageability	X				X	X	
Accessibility	Urban obstacles	X	X	X		X	X	
	Rest areas	X	X				X	
	relief	X	X	X				
Legibility	Pedestrian signage	X	X		X	X	X	
	Landmark elements	X	X	X		X		
Pedestrian safety	Pedestrian crossings	X	X			X	X	
	Characteristics of sidewalks and pedestrian paths	X	X		X	X	X	
	Road traffic calming	X	X		X	X	X	
04		**Study of sociability in the area of intervention**						
Interactions between people		X	X			X	X	

The meeting areas	X	X			X	X	
Social involvement	X	X				X	
Mixed use of spaces	X	X			X	X	
05	**Study of urban environments in the area of intervention**						
Pedestrian attractiveness	X	X			X	X	
Possibility of stay	X	X			X	X	
The distributors	X	X				X	
Mobilization	X	X				X	
06	**Study of the characteristics of uses**						
Types of walking	X	X				X	
The pace of walking	X	X				X	

C.R: Commented routes - D.O: Direct observation - C.S.A: Cartographic and statistical analysis - S.S.I: Semi-structured interviews – WA: Walkability audit – S: Survey – SS: Space syntax

Table 02: Summary of research objects and methods used. Source: Authors, 2018

4. RESULTS AND DISCUSSION:

4.1. Study of the characteristics of the spatial structure and the urban form:

4.1.1. Travel distances:

The study demonstrated that several factors, such as the presence of important facilities and services, functional diversity, and the existence of a diversified network of public transport lines, all contribute to increasing the use of walking in the Lekhmis district, but despite this, and despite the lack of parking spaces in the area, we noted a particularly excessive use of the car.

4.1.2. The network: Connectivity, continuity, visibility: To analyze these elements, we carried out the axial analysis, the result obtained and represented in the map opposite (figure 05). Colors range from blue to magenta. Red, magenta and yellow: represent the highest values in the spatial system, they are the most integrated spaces or paths. Green, cyan (blue-green): represent the medium high colors in the spatial system, they are the least integrated spaces or paths. Blue and indigo: represent the lowest values in the spatial system, these are the most segregated spaces or paths.

After performing the connectivity test for the Lekhmis district using the "Depthmap" software, we obtained the result which is shown in Figure

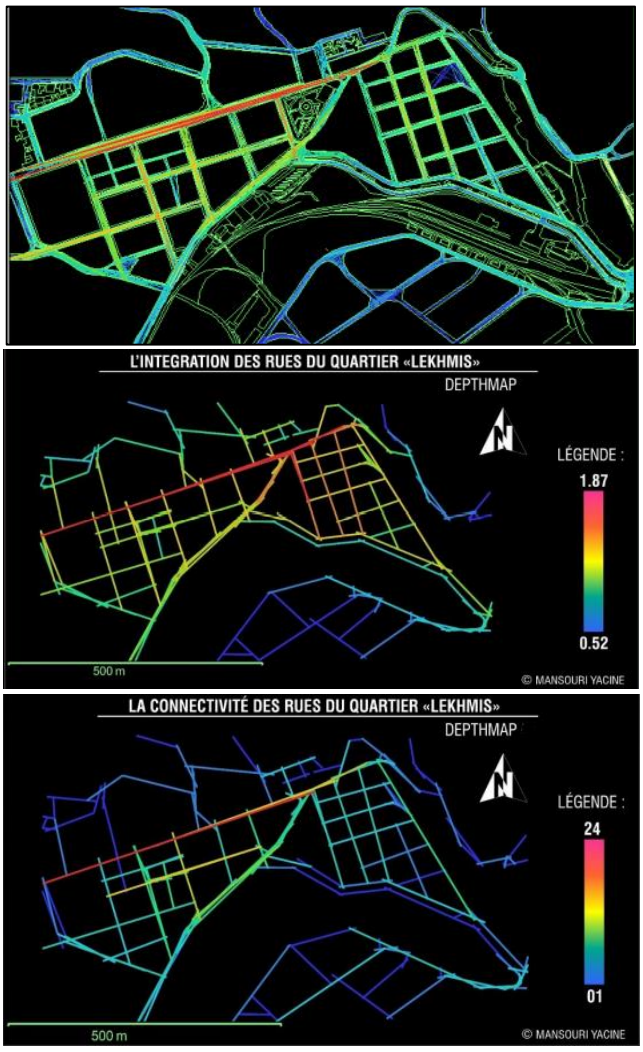

Figure 05: Axiale maps, integration and connectivity, Authors, 2018

05. After the projection of the results of connectivity in the entity analyzed, it emerges that the streets of the Lekhmis district represent a clear variation in the degree of connectivity, the latter varies between 01 and 24. The streets which benefit from a number most important of connections (in magenta, red and orange) are the streets of the upper part of the district, the best connected street is the street "Rue de la Liberté" (in red color) with a degree of connectivity of 24.

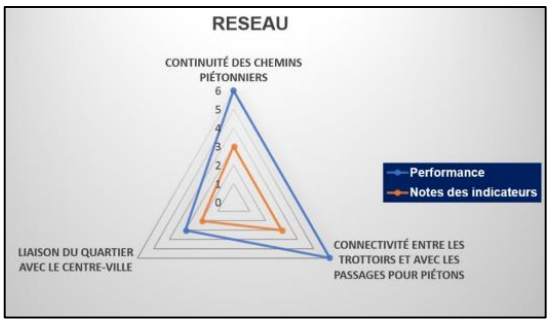

Figure 06: Audit result for "network", Authors, 2018

In each study, "Rue de la Liberté" features the highest degree of connectivity, integration, choice, and even visibility. "Rue Moukay Ennacer", which is the most important in the district after "Rue de la Liberté", marks a very low level at each test, this is also mainly caused by the presence of the major cut in the district which is caused by the railway. (no connection from the upper part of the district to the lower part). However, the questionnaire survey showed that a certain number of pedestrians (60%) among those who already know the neighborhood (residents, shopkeepers, etc.) prefer to avoid Liberty Street, despite its high score obtained from the study. space syntax. This is due to multiple reasons, collected mainly by the method of commented walks, and presented in this work. Most tourists, on the other hand (88%), prefer to go through "rue de la Liberté" to reach the old town, or simply to walk around or visit the shops. This is explained by the fact that connoisseurs of space already enjoy a mental image strongly impregnated with places (which we have tried to understand thanks to the method of guided tours). This image created over time is the result of a complex perceptual process. It is indeed responsible for generating the behavior of pedestrians and their route choices. The major disruption caused by the railway line is a major obstacle that significantly reduces the connectivity of the neighborhood. City officials should think about how to solve this problem in the coming years in order to improve the situation and therefore improve walkability. The intense traffic of vehicles along the main axes creates obstacles which pose a problem for pedestrians since they prevent them from following continuous paths.

4.1.3. Permeability: Based on the results obtained from the various research methods used, in particular that of commented routes, we have noted that the Lekhmis district has shortcuts and passages which give pedestrian traffic more fluidity. Here we can give the example of the following passage next to the Sidi Abdelhak mosque (fig. 08). The map shows that the urban fabric of the district of Lekhmis is in checkerboard, and after having calculated the dimensions and surfaces of the blocks in the study area, we found that the average size of the latter is "155 × 155" this which comes very close to an ideal size. It remains to be noted that despite the fact that this checkerboard pattern covers a large area of the district, other areas remain not very permeable and not easily accessible to pedestrians, it is essentially two lateral

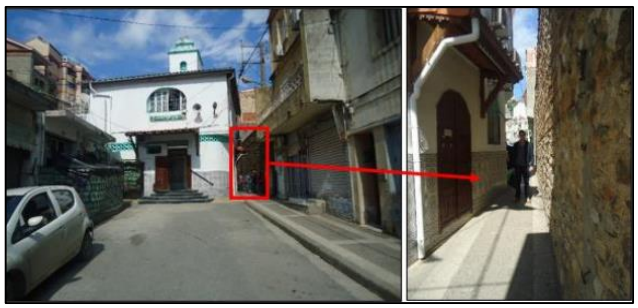

Figure 07: Example of permeability in the neighborhood, Authors, 2018

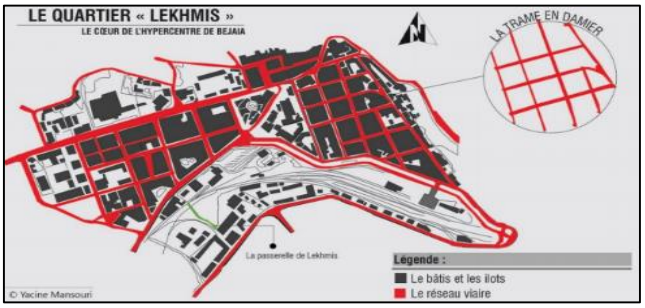

Figure 08: the permeability map, Authors, 2018

parts of the district given the presence of anarchic constructions and the lack of paths intended for pedestrians.

Not observing many desire lines inside the Lekhmis neighborhood is also a sign of good permeability. The questionnaire showed that the majority of people (69%) confirmed finding it easy to move from one place to another in the neighborhood, and 51% believe that in the majority of cases, there is an easy way to move.

Figure 09: Urban stairs in Lekhmis, Authors, 2018

Following this survey, it can be concluded that the Lekhmis district has good permeability, whether mechanical or pedestrian. This is especially true for the central area of the district, which is a significant advantage. However, it should be noted that several of the places we mentioned earlier, require work to improve their level of permeability, especially where desire lines are present.

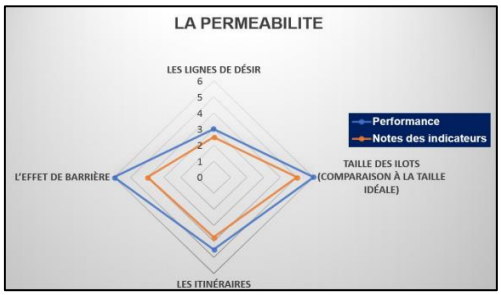

Figure 10: Audit result for "permeability", Authors, 2018

4.1.4. Accessibility: It can be seen from reading the map above that several mechanical entrances give access to the Lekhmis district and in several different directions, this is an essential factor which contributes to increasing its walkability score. The district of Lekhmis, is built on a relatively flat site which facilitates travel. However, one of the problems most reported by those interviewed is the lack of a direct connection between the neighborhood and the Boulevard Amirouche which leads to the old town. A very old staircase (dating from the colonial era) badly maintained and badly laid out between these two parts thus taking on a repulsive character. People therefore prefer to go, for example, through Touati Laarbi, as a resident says: "*I find it difficult to climb from this district to Boulevard Amirouche to go to the old town, the stairs built by the French at the colonial era are not maintained and the passages are insecure*". The questionnaire survey also showed that there are few adequate facilities for resting along the pathways, especially for the elderly and children. Some facilities are degraded and poorly maintained, which reduces the possibility of staying in the neighborhood. The layout of the neighborhood must be redesigned to include rest and meeting areas, as well as devices allowing the elderly and people with reduced mobility to walk freely without obstacles or dangers. A low level of accessibility discourages people from walking, thus lowering the level of walkability.

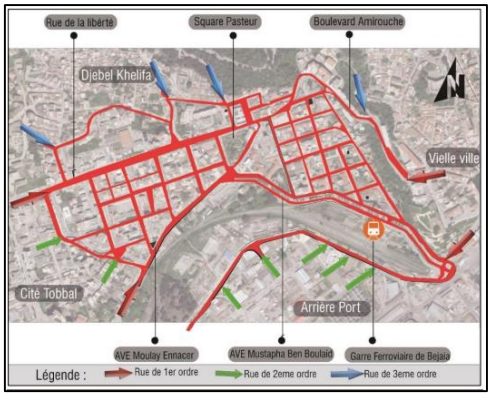

Figure 11: Accessibility map, Authors, 2018

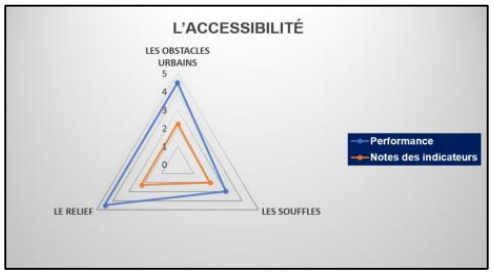

Figure 12: Audit result for "accessibility", Authors, 2018

Figure 13: Urban staircase in Lekhmis, Authors, 2018

4.1.5. Legibility: 64 percent of pedestrians believe that there is a great shortage of signs to orient themselves towards the hypercentre and 54 percent believe that the majority of interesting places in the neighborhood are not indicated by road signs. Visitors, on the other hand, reported obvious difficulty finding their way around the Lekhmis district due to a lack of legibility, especially in key locations. Some locations are difficult to locate; and access to key places is not always easy, such as Place Ifri, which is not easily identifiable despite its good location in the city. There is a glaring lack of pedestrian signage in the hypercentre of Bejaia, as no planned work has been carried out. The clarity of the delimitation of spaces and important public places must be worked on, and the many entrances and exits of spaces and buildings must be materialized to allow pedestrians to easily navigate the space.

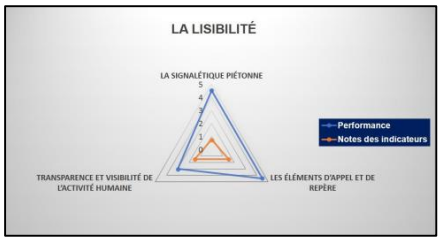

Figure 14: Audit result for "Legibility", Authors, 2018

Figure 15 : Place Ifri à Lekhmis, Auteurs, 2018

4.1.6. Pedestrian safety:

From the results of the pedestrian safety audit and combining with the other methods, it can be concluded that the lack of pedestrian crossings in Lekhmis district is one of the main reasons for pedestrian insecurity. We will of course include school entrances which are, in the vast majority of cases, not secure. The presence of several damaged sidewalks, as well as some pedestrian paths that do not secure the movement of pedestrians, considerably reduced the walkability score.

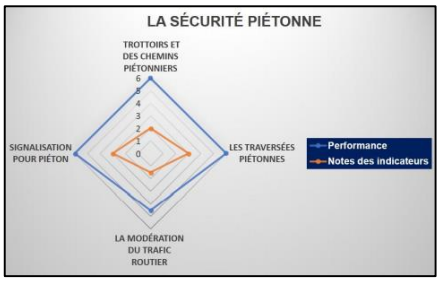

Figure 16: Audit result for "pedestrian safety", Authors, 2018

Conclusions:

We can conclude after this study that the hypercentral area of Bejaia is not sufficiently walkable. This is mainly due to the lack of consideration of the factors inherent in walkability in urban development operations. Several measures must be taken in order to improve the urban stay for the benefit of a quality pedestrian wandering. Despite the large number of pedestrian spaces created in our cities, they are still far from achieving the expected success that meets the expectations of city users. These spaces are reduced in their majority to simple supports of movements far from favoring social interaction in a secure and reassuring atmosphere. This suggests that they are not sufficiently "walkable", especially since research approaches on this subject often remain focused on quantitative factors studied on a large scale. However, we were able to study the impact on the "walkability" of factors such as connectivity, permeability, distribution of land use, population density, security or network planning, etc. But these elements alone are not enough to stimulate walking. In addition, the number of users in the spaces studied does not automatically confirm that the place is particularly walkable, because certain spaces can be used by "obligation" and not by "choice" as we have seen in the neighborhood. Lekhmis in Bejaia.

The quality of the urban landscape directly affects the perception and behavior of walkers and plays a very important role in the level of use and appropriation of urban spaces. Regarding the methods used, the study of perception through InSitu approaches is therefore essential to achieve more effective and safer results in the study of walkability. The exploration of spaces through users, acting as social and embodied beings, and their physical and mental perceptions, although already developed, is still little practiced in contemporary literature and especially in highly characterized urban and landscape contexts, like the Maghreb urban fabrics. Experimentation in these environments can bring out clues revealing specific characters and qualities to be reconsidered in a process of reactivating soft mobility. The mental and lived appropriation in these built landscapes will make it possible to identify the reasons for the already there, in order to explain what they bring to meet the challenges of sustainability and quality.

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