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The Influence of Urban Configuration on Movement and Commercial Activity: Case of Residential Neighborhoods in the Biskra City Center, Algeria

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Abstarct

This article seeks to explain the effect of the urban configuration of residential neighborhoods on movement and commercial activity by focusing on visual accessibility as a spatial quality. The research consists of making a comparison between the spatial parameters related to the latter and the results of pedestrian and mechanical movement counting as well as commercial activity. We used two techniques: the axial MAP, that is as one of space syntax and the gate counts method, which allowed us to count the movement and the trade stores distributed in two neighborhoods of Biskracity (located in the South East of Algeria). The comparison of the obtained data demonstrated several results explaining the concordance of the spatial characteristics, in particular that of our research, with the movement and presence of commercial spaces. In addition, research has highlighted the role of spatial parameters on certain social behaviors.

Key words: Urban configuration, Residential neighborhood - Visual accessibility, Movement - Commercial activity- Space Syntax.

INTRODUCTION

The architectural or urban space constitutes the physical framework in which man practices his fundamental activities. It must be thoughtfully and thoroughly designed to support different functional, social and emotional needs. He identified himself by his own perceptual and functional characteristics that are considered to generate social behaviours (Fezzai, 2018). The relationship between the spatial dimension and the social dimension has been the subject of several areas of research, particularly in the field of human sciences. On the one hand, this relationship lies in the influence of the physical environment on society, on the other hand in the influence of social rules on the environment(Hillier,andal. 1984). This alliance gave birth to the Space Syntax paradigm by Hillier and Hanson at the Bartlett School of Architecture and Planning from the 1970s(Hillier, 1987). The syntactic approach focuses on the spatial configuration as a major concept that permits us to comprehend the structure of the spatial system and its impact on movement and land use(Hillier, 1996b).

The urban configuration is a concept that defines the characteristics of the different elements that make up the urban space as well as the relationships by which they are structured and form the totality (Hillier,and al.1993). The configurational approach is based on the analysis of the topological characteristics of the street network, which reveal the spatial movement of individuals in urban spaces. It is very relevant given its ability to predict the frequency of movement in the streets of the city or part of it(Lerman,and al. 2014).

Based on the observation of certain neighborhoods, we have found that the use of the streets by people for movement or to practise certain activities differs from one place to another.Some spaces have a high pedestrian and mechanical traffic, while others are less frequented by us. To clarify the relationship between the properties of space and land use, we are interested in this research on the influence of the urban configuration on pedestrian and mechanical movement as well as on the location of commercial activities. The study focuses on visual accessibility as a quality of system configuration. It tries to confirm or invalidate the conclusions of certain previous studies that have used the tools of Space Syntax. Our case study includes two predominantly working-class residential neighborhoods located in Biskra city centre. They are characterized by high pedestrian and mechanical traffic as well as a high concentration of commercial activities in some places.

THEORETICAL FRAMEWORK

Many studies confirmed the role of spatial factors on navigation, the most important of which is the metric distance. However, the recent cognitive studies science have concluded that the metric distance hypothesis is unrealistic (Hillier, and al. 2005).

This is not to say that we are not looking for the minimum distance in an itinerary, but because our notions of distance are dependent on the visual, geometric and topological properties of the urban network. For example, distance values are affected by the discrete visual segments of roads (Golledge, 1992 ; Montello, 1997 , Kim, 2001; Hillier, and al. 2005). The various studies of Hillier conclude that people move according to the visual qualities of the spatial configuration of the street network. For this reason, he developed his theory based on the topological visibility of the physical environment (Hillier,and al. 1993; Turner, 2007; Jiang, 2009a; Lerman, and al. 2014).

The visibility of the environment is not only the possibility of being seen, but also allowing the individual his own image so as to orient himself and move easily (Lynch, 1960). The origin of visibility goes back to the work of Benedikt (1979) who introduced for the first time the concept of *Isovist* or the field of vision, i.e. the set of points visible from a point of view in a given environment.

Visibility enables the first contact that man has with the outer space. It makes it possible to constitute the visual image, which provokes the mental system to translate it into a cognitive reaction, which develops into sensations or a particular behaviour. Visibility can determine the mode of interaction. It depends on the characteristics of the space,the way to know it and to use it follows with behaviour such as movement, immobility or other (Rezig, 2013). Good use of urban public space requires certain qualities, in particular visibility;the latter influences the spatial behavior of the city. In addition, the visibility parameter is a significant element for interpreting the space and qualifying these constituent elements. For example, inter-visibility indicates the convexity of space, while continuous visibility signifies the extension of space (Al-Sayed,and al.2004;Fazzami, 2020)

The visual accessibility of movement spaces is an important quality that determines the way in which users know and use the whole system(Turner,and al. 2001; Parvin, and al. 2007). Parvin, and al. (2007) explored the relationship between visual accessibility and pedestrian movement. On an area of Hong Kong (Telford Gardens) characterized by a compact urban form, large mixed-use buildings, a high-capacity transit system and various transitional spaces.The results show that in spite of the complexity of the space system, the visual dimension plays a very important role in guiding people in urban spaces.

The human movement is not a coincidence or a single step,it is often both planned and formed in n-step(Hillier,and al. 2005). Based on the fact that the configuration of the urban network is considered to generate movement. Hillier developed the theory of natural movement as the most outstanding component in urban spaces(Hillier,and al. 1993). It refers to the capacity of the street layout itself to predict pedestrian movement.(Hillier,and al. 1993;Koohsari, and al.2019). Natural movement theory can reveal the relationship between street layout and land use, these are two important elements that promote pedestrian and mechanical use (Millward, and al. 2013; Sugiyama, and al. 2012; Wineman, and al. 2014; Witten,and al. 2012;Koohasari,and al. 2019). Natural movement can come in two types; "To-movement" or the movement towards a destination. The "Through-movement" or the crossing movement represents the passage of pedestrians from one point to another from the shortest paths in the system (Hillier,and al. 1993). This movement gives urban spaces a feeling of life and security, which is reflected in the economic aspect of the city (Penn, and al. 1998).

TECHNIQUES AND METHODOLOGY

The Axial Map

The Space Syntax approach includes techniques for modelling and analysing urban spaces as a spatial configuration. The axial map is one of the most used means to reveal the characteristics of the configuration of urban systems. It is also called a topological map, because it reduces spatial morphology to spatial topologyit represents all the relationships by which man is linked to his social and spatial environment(Chiaradia, 2004, Laouar,and al. 2019). The axial map is made up of the minimum of the longest possible lines of sight crossing and the maximum of convex spaces (Hillier, and

al.1984 ;Desyllas, 2001). It indicates the degree of visual accessibility from the point of view of a person moving in the urban space (Hillier, 1996 ;Lerman,and al. 2013). Axial analysis can identify some basic measures of the first and second degree:

The Integration

It is a static global measure. It is based on the depth or the topological distance of a space in relation to the other spaces of the system, that is, the spaces that need to be traversed in order to arrive at the space concerned (Hillier,and al. 1984). The integration value of an axial line reflects its average linear depth relative to all other lines in the system(Hillier, 1996). This measure predicts the "To-movement", it concerns foreigners who depend on reading the trace to move(Hillier et al., 1987). Integration can be local when it is calculated up to three lines or three radii or global when it is calculated up to radius-n(Hillier, 1996).

The Choice

It is a dynamic global measure. It reflects the probability that an axial line will be used as a passage through the shortest routes to all other spaces in the spatial system(Hillier, and al. 1986a ; Hillier,and al., 1987). This index is calculated based on the location of a given axial line on the shortest topological itinerary between all other axial lines in the network(Lerman, 2014). The choice is a good indicator of movement in particular the "through-movement"(Hillier, 2012),it's the movement of inhabitants who know the roads and the corridors(Hillier,and al. 1987).

The Connectivity

It is a local, static measure that represents the number of spaces directly connected to the space in question(Jiang,and al. 2000). The axial connectivity shows the number of lines connected to the line concerned (Mazouz, 2013).

Intelligibility

It is a second degree measure. It represents the correlation between the connectivity measure and the integration measure(Hillier,andal.1987). Intelligibility indicates the ease of reading the global structure from a local position(Al-Sayed, and al. 20014). This measure predicts certain potentialities of the urban space, in particular the movement(Penn, 2003).

Synergy

The synergyshows the correlation of local and global spatial system integration values. It consists of measuring the dependence of a spatial entity on the global system(Hillier, 1996; Al Sayed, 2014). The synergy indicates the performance of urban spaces in terms of movement, in particular "through-movement" as well as the use of these for commerce or other(Penn,and al. 1998). The levels of integration and synergy of spaces with regular geometry can be a good indicator of future visitor behaviour (Safari, 2017).

The Gate Count Technique

This method measures the density of movement in urban spaces. It allows collecting important data and values that can be represented in graphs and tables. It is based on the observation of several points or doors in the studied space. Itnecessitates a number of observers who can deal with an area with certain points that are essentially imaginary lines, the number of these points is around 16 or more per observer for an area and with an observation time of 2.5 or 5 minutes depending on the degree of movement. The counting of the movement is also carried out during several repetitive rounds, each round takes into account the counting time and also the time of displacement from one point to another(Al-Sayed,and al. 20014).

Plan Modelling

The research proceeds by modeling two residential neighborhoods located in downtown Biskra by the Space Syntax method using the Depthmap10 © software, developed by Alasdair Turner at UCL, and the Syntax 2D program developed at the University of Michigan (Güney, 2007). The software offers axial maps that present us with both global and local syntactic measures related to urban outdoor space.These were compared with the results of counting pedestrians using the "gate counts" methodperformed on two days of the week and from 8.00 a.m. to 6.00 p.m. The axial maps were first drawn up on the basis of the plans selected from the PDAU of the city of Biskra and then updated taking into consideration the visual obstacles of 1.20 m in height or more.

The Field Survey

The survey was carried out by the "gate counts" method on an area onBiskradowntown. It is composed of two residential neighborhoods,these were chosen fortheir particularities with regard to certain criteria such as the location, the morphology of the urban space and the period of construction. The work was carried outin November 2019 in good weather. The counts were made on 178 points or "gates" spread over 92 streets (Figure 1). The procedure was started at the same time by the investigators, from 8 a.m. until 6 p.m. for two days: a weekday (Thursday) and a weekend day (Friday). The work is in the form of repetitive rounds every two hours. It consists of both the observation and counting of pedestrians as well as vehicles as they cross the "gates" in both directions of the streets. The results were collected and elaborated on tables.

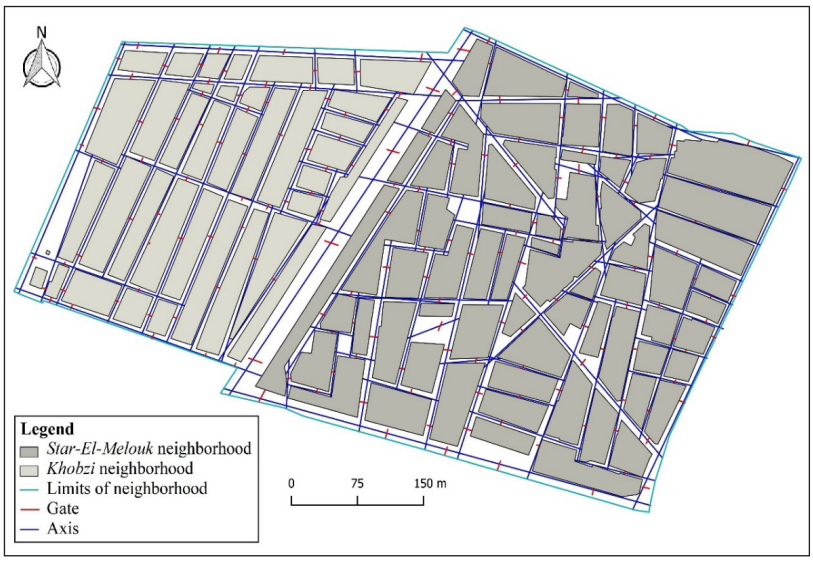

Figure 1. Ground plan shows the "gates" location. Source: Author

Data Processing

The processing and representation of the axial maps from Depthmap10© and the results of the field survey by the "gate counts" technique were carried out by the QGIS 3.16® software, the procedure consists in exporting the plans of the neighborhoods and the maps of the axial analysis in the form of layers. Then, another layer representing the "gates" was integratedspotlighting the gates layouts as well as their data recorded during the survey. Once the layers were established, we proceeded to intersect these layers, this allowed us to count the number of pedestrians and vehicles for each axis that will be confronted with the syntactic parameters of it such as choice, integration, connectivity, etc. The confrontation of the results was carried out by the Depthmap10© software where we injected the pedestrian counting data in the form of a new attribute, this allowed us to bring out the correlation coefficients (R2).

CASE STUDY

Star-EL-Melouk neighborhood and Khobzi neighborhood

The case study chosen is composed of two distinct neighboring neighborhoods with an area of (30.16 H). The *Khobzi* neighborhood and the Star-El-Melouk neighbouhood located in the city center of Biskra, limited to the North by *Ferhat* neighborhood, to the south by two neighborhoods *El-Saihi* and *Elcarte-Bukhari*, to the east by the city *El-Badr*, to the west by the railway and the city *El-Izdihar*(Figure 2). The *Khobzi* neighborhood was created following an extension of the *Ferhate* or *El-Dhalaa*district which belong to the colonial era. It is characterized by a regular urban form made up of blocks, the majority of which are rectangular in shape and arranged in a linear fashion, forming straight streets with increasingly narrow widths. The *Star-El-Melouk* neighborhood is the result of an extension of the old core of the city of Biskra on private agricultural land. It keeps the same characteristics of the traditional Saharan fabric such as urban compactness, the irregular layout of streets and alleys. They are separated by a structuring axis of the city named *Zaâtcha*street, it also represents the national road (RN3). It is a double road with fairly wide sidewalks, bordered on both sides by dedicated linear arcades for commerce.

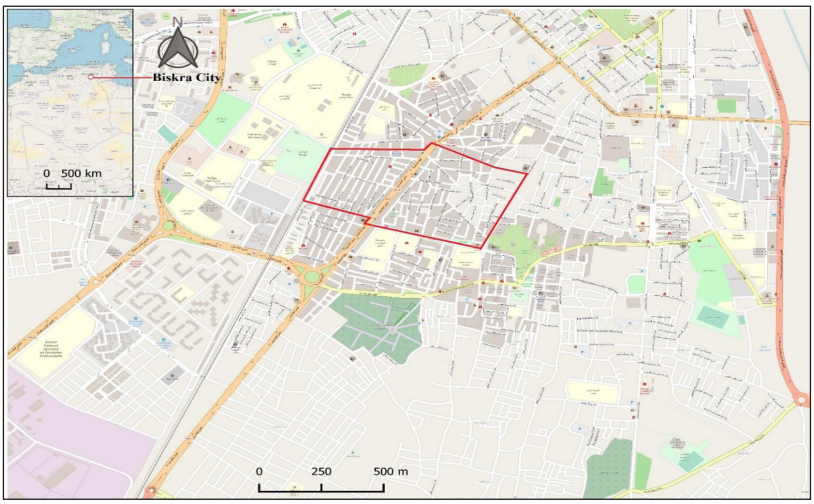

Figure 2. Location map of *Star-EL-Melouk* neighborhood and *Khobzi* neighborhood. Street Map QGIS 3.16. Source: Author

RESULTS AND DISCUSSION

The confrontation of the variables indicates a strong correlation between the pedestrian movement and the choice during the weekend day (R2=0.685) and an average correlation (R2=0.57) on the weekday (Table 1). Where we have seen during the latter a high density of movement on certain commercial streets although they display medium or low choice values. It concerns the southern part and the central street of the *Star-El-Melouk* neighborhood that includes animportant number of formal and informal commercial spaces,forming (the souk "*Souk-El-Boukhari*"). However, there is a weak correlation of pedestrian movement with global HH integration (R2>0.40) and local connectivity; this is mainly due to certain axes which are poorly frequented, although they display high integration and connectivity values; this is the northern part of "*Star-El-Melouk*" which contains streets connecting the centerof neighborhood with *Zaâtcha* street. Concerning the movement of vehicles, we note that it is moderately correlated with the choice during the weekday (R2=0.502), on the other hand, it is not correlated with the other syntactic variables. This means that the streets that offer more possibilities leading to the maximum spaces are the most used for pedestrians and vehicle drivers. Furthermore, the results gave very significant correlation coefficient values, more than that,there is a correlation between two global measures (integration and choice) and commercial activity. Likewise, there is a correlation between the latter and the pedestrian movement. The results indicatethat the spatial system promotes natural movement, in particular "Through-movement" given the correlation between the measure of choice and the movement. It partially allows the "to-movement" on the integrated streets of the periphery, such as *Badi Mohamed* Street to the east, which leads to the *Zgag-Ben-Ramdane Souk* and the city center, the long streets of the *Khobzi* neighborhood which lead to the *Zaâtcha* street.

Table 1. Correlation coefficient R2 of syntactic variables with pedestrian movement, vehicle movement and commerce. Source: Author

	Movement -Weekday		Movement-Weekend		
Syntactic variables	Pedestrian	Vehicle	Pedestrian	Vehicle	Commerce
Integration HH	0.370	0.191	0.398	0.160	**0.520**
Choice	**0.575**	**0.502**	**0.685**	0.437	**0.676**
Connectivity	0.231	0.04	0.349	0.045	0.394
Commerce	**0.768**	0.379	**0.561**	0.321	

For more details, the results of the previous table display two axial maps, which represent the movement with respect to two measures(integration HH and choice). The maps indicate that the frequency of movement differs in the different

streets during the two survey days; it is very high during the weekday compared to the weekend. It can be seen that pedestrians are concentrated on the central axis, which represents *Zaâtcha* street and the southern peripheral street which is called 19 June street (Figure 3). These two principal corpsare the most integrated with a maximum value between (2.64-2.69), they also display the highest choice values (2740-1958). It is a little less on weekdays on the streets linking 19 June street with the center of the (*Star-El-Melou*k) neighborhood, these are integrated contrary to their low values of choice, with the exception of *Mokhtar Abdelghani* street which displays an average value of choice (1462). Pedestrian movement on previous roads represents "Through-movement" and "To-movement",they contain the majority of commercial activities. Pedestrian movement is average on roads with average choice and integration HH values. These are the peripheral roads and the longest and rectilinear interior roads of the *Khobzi* neighborhood. It is average on certain integrated interior roads of the *Star-El-Melouk* neighborhood, although they show low values in choice, these connect the interior of the neighborhood with the 19 June street. In addition, secondary roads with low values are the least used by pedestrians; they represent the routes and alleys least connected with all or part of the urban system.

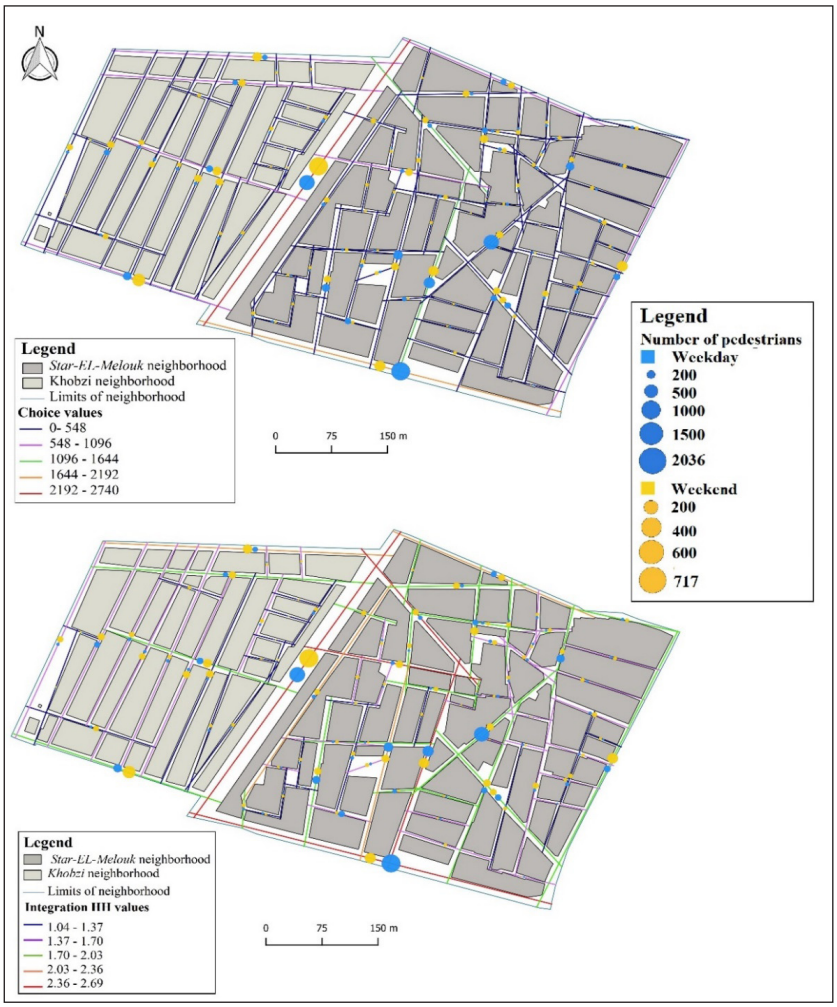

Figure 3. Axial Map: represents the values (integration HH, choice) and the pedestrian movement. Source: Author

The confrontation between the measurements of the axial analysis and the number of vehicles traversing each axis indicates that the movement of vehicles is very important during the weekday compared to the weekend day (Figure 4).The most flow of vehicles was recorded on *Zaâtcha* street, it is a slightly less on 19 June street. These two corps present very high syntactic values. The mechanical movement is also average on the street of the eastern limit of the *Khobzi* neighborhood although it displays low syntactic values, it is named *Frères Osmane* street. On the other hand, streets with low choice and integration values are the least used for mechanical traffic. So, we can say that vehicle users prefer long streets with good visual accessibility, which in turn influence physical accessibility.

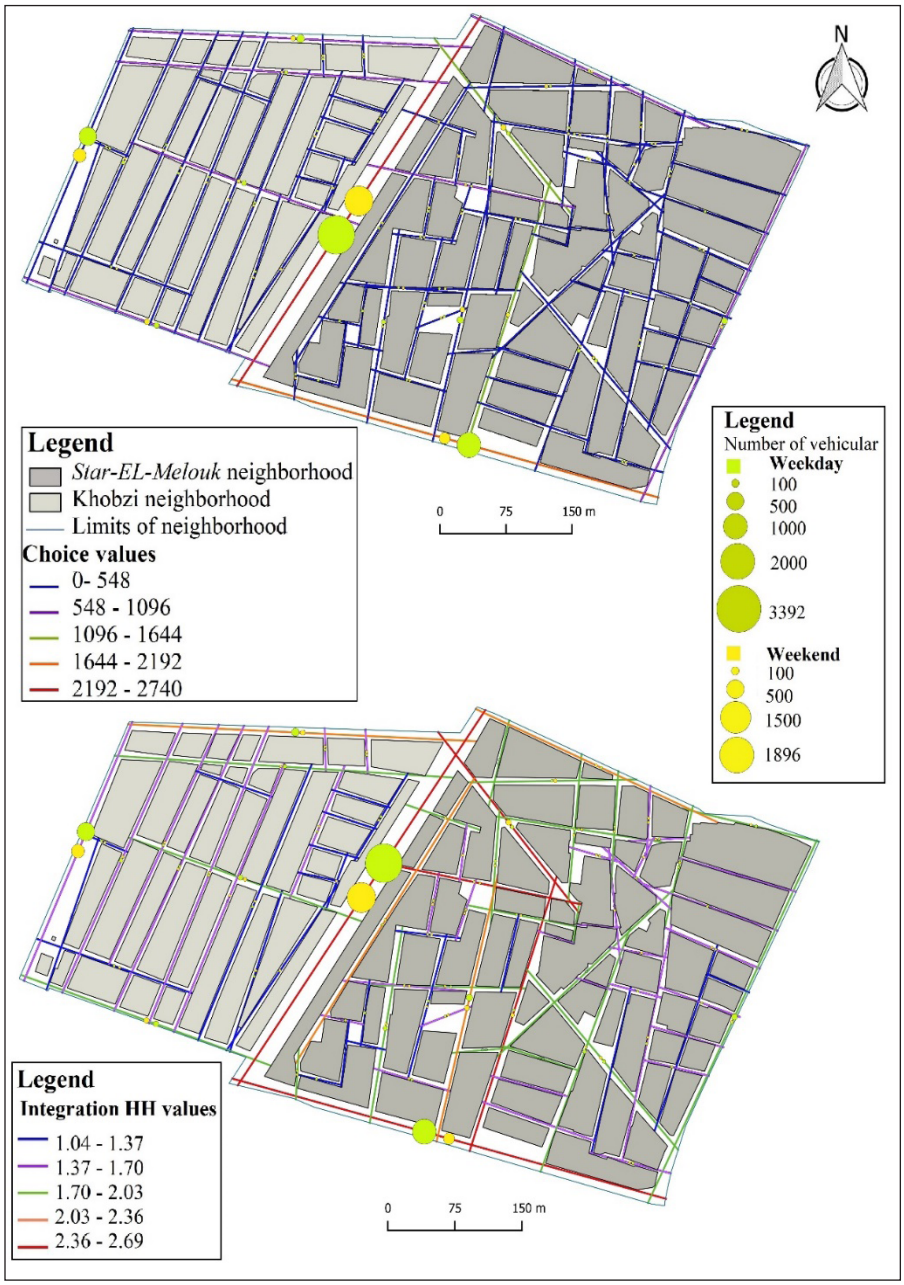

Figure 4. Represents the measures (integration HH, the choice) of axial mapand the vehicle movement. Source: Author

Confrontation of syntactic measures from axial maps and commercial spaces (stores, boutiques and others), shows that streets with high values of choice and integration are the most preferred for commercial activity. The latter is more concentrated on the *Star-El-Melouk* neighborhood, which has more integrated spaces compared to the *Khobzi* neighborhood. The commercial activities are distributed in particular on the *Zaâtcha*street which includes the most important number of shops, boutiques, restaurants and cafes. The southern part of *Star-El-Melouk* (P1), which includes the axis of the 19 June streetand the four roads connecting the center of the neighborhood from the latter, it contains retail commerce dedicated to women (vending tissue, clothing, cosmetics and jewellery). Commercial activity is average on streets with average syntactic values,such as the southern part (P2) (Figure 6) which contains the retail commerce (supermarket, craft shop, spice grinding), the street at the Eastern edge is named *Badi Mohamed* street which is dedicated to the sale of accessories and the maintenance of motorcycles and bicycles. There is also an average presence of commercial activities on the northern peripheral street of the *Khobzi* neighborhood named *Kadouri Salah*street, it is dedicated for the daily activities of the inhabitants. In addition, streets with low choice and integration values are the least used for commercial activity, the majority of which is absent.

Figure 5. Photos show the commercial part of *Star-El-Melouk* neighborhood(*Souk-EL-Boukari*). Source: Author

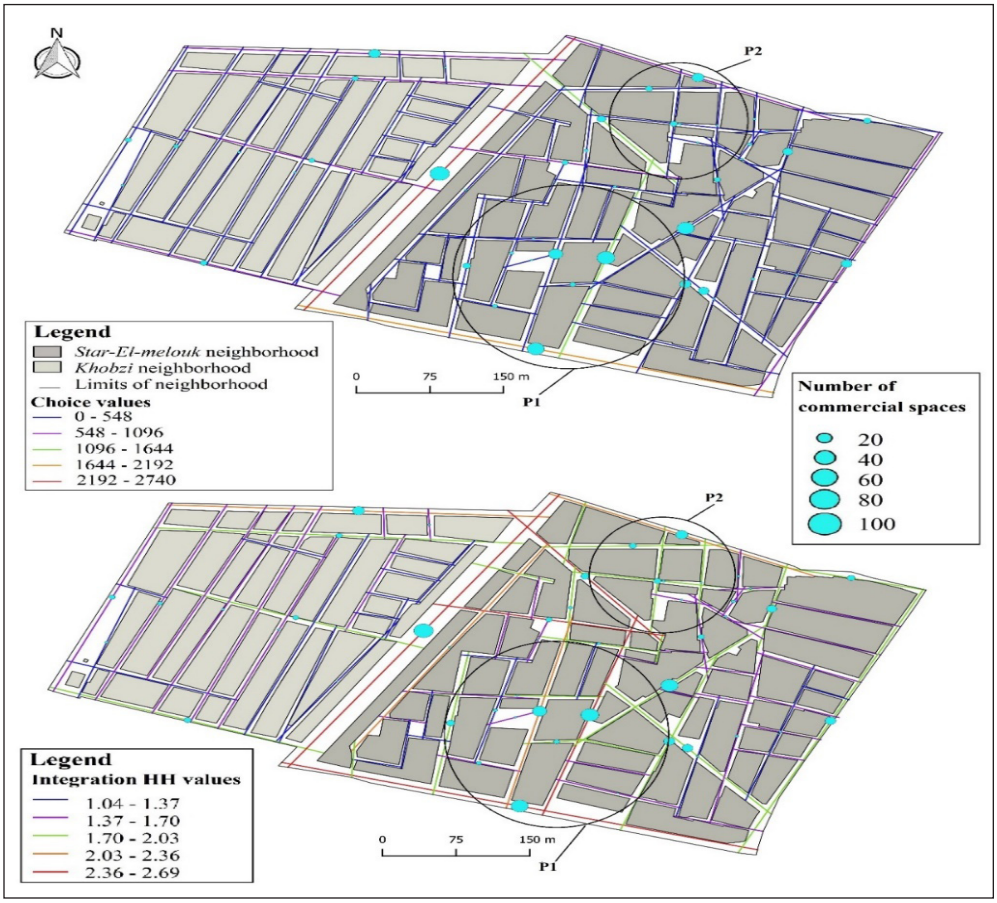

Figure 6. The distribution of commerce in relation to the measures (HH integration, choice) of the axial map. Source: Author

The intelligibility graph (Figure 8) displays an average correlation coefficient equal to 0.514 between the global dimension (HH integration) and the local dimension (connectivity). The urban fabric in its overall configuration is moderately intelligible, which makes the system clear to users, it can be read from its constituent elements. This quality makes the spatial system accessible and allows the movement of individuals in the different outdoor spaces. The axial lines with high values of integration and connectivity are the most frequented like *Zaâtcha*street, 19 June street and the wide road linking the center of the *Star-El-Melouk* neighborhood with 19 June street

The synergy or analysis of the local effect (Figure 9) has a very high coefficient (R2=0.80), which explains a strong moderation and a more coherent relationship between the different local areas and the global system. So, the urban system is open to its users. This allows the use of spatial component spaces and promotes movement particularly"through-movement".

Figure 7. Photos show *Zaâtcha* street and a segregated road of the *Khobzi* neighborhood. Source: Author

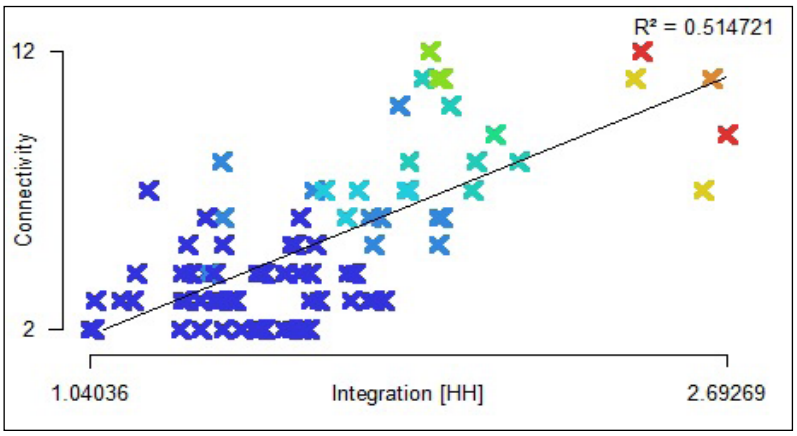

Figure 8. Intelligibility graph. Source: Author

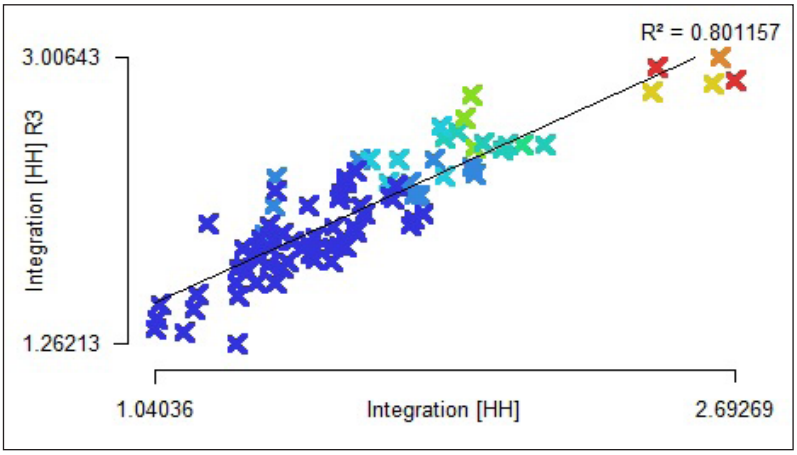

Figure 9. Synergy graph. Source : Author

CONCLUSION

We concluded through this research that global choice is a good predictor of pedestrian and mechanical movement compared to integration and connectivity, saw the correlation coefficients recorded within two weekdays. The urban configuration therefore promotes "Through-movement" and allows the movement of local users with a good knowledge of the urban system. This observation is confirmed by the high value of synergy compared to an average value of intelligibility. In addition, the urban configuration does not allow "to-movement" in its totality given the weak correlation between integration and pedestrian movement, although there is a trend of this type of movement through some of the most integrated axes, these are also the most concentrated by commercial activities. This is confirmed by the value of the correlation coefficient (R2=0.52) obtained between from the latter and the HH integration. Long roads displaying strong values of choice and integration are the most used in pedestrian and mechanical movement, because they offer

good visual accessibility compared to other, that is to say, a clear and prolonged visibility, allowing linear movement towards one direction or the possibility of choosing other directions, given their connections with other streets in the system.

The intelligibility and synergy graphs (figure 8 and 9) indicate that the same streets are the most intelligible in the system. In addition, these streets include the majority of shops and boutiques as well as public facilities. The syntactic parameters are then, good indicators determining the physical accessibility conditioned by the visual accessibility.

Spatial modeling through the axial map makes it possible to read not only the urban configuration, but also to predict the use of space and the way in which commercial and public activities are located. Axial analysis offers us how spatial qualities can be considered and exploited in one way or another, sometimes outside the official framework. The commercial part (*Souk-EL-Boukari*) is a concrete example resulting from the spatial configuration. It is composed of several streets mostly integrated, in the *Star-El-Melouk* neighborhood, in particular the 19 June streetas well as the roads and alleys leading to the center of the neighborhood. Furthermore, the absence of spaces capable of satisfying the social needs of the inhabitants, the majority of segregated streets in both neighborhoods become spaces for social interactions such as play and dating. They constitute places of conviviality thanks to their narrowness,the presence of many accesses from homes that overlook these streets, ensuring control and security, in the absence of commerce or other activities likely to upset the tranquillity of the inhabitants.This confirms what was pointed out by (Hillier,and al. 1984) where segregated spaces are the most secure for the inhabitants.

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