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Analysis and reading of the quality of an urban public space via space syntax

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Abstract. Biskra is one of the Algerian cities that has undergone a very accelerated evolution through the different periods of its history. It is confronted with serious problems related to various dysfunctions in particular in its planned urban structure and in its social structure suffering from several social ills, whether in: housing spaces, equipment or urban public spaces. The latter present many anomalies depending on the consumption of space, identification, orientation and behavior. The objective of this work seeks to read and analyze the quality of permeability and legibility in urban public spaces in the neighborhood of El-Alia northeast Biskra, how the space affects the movement of pedestrians and therefore their behavior and to make a comparison between what exists in reality and what is proposed in the development plan of the neighborhood of El Alia northeast by the Office of Studies and Achievements in Town Planning URBA in terms of these two concepts, in order to affirm or deny whether the design of the spatial structure proposed by the URBA has remedied the various deficiencies and anomalies in the existing. We proposed as a model of analysis and reading the combination of two methods obtained from the literature, namely the method of responsive environments and the method of space syntax.

Keywords. Space Syntax, Urban Public Space, Spatial structure, Permeability, Legibility

1. Introduction

In the functioning as well as in the form of the city, urban public spaces have always played a very important role. A central and structuring role in the construction of the city and in the architectural and urbanistic thought. The image of the Algerian city is the result of successive evolutions of several times, their development is linked to historical, economic, cultural and natural conditions. Today the urban reality is confronted with serious problems, with an imbalance and a dysfunction between a planned urban structure and a social structure suffering from social and psychological evils. Through the great periods that the Algerian city has experienced, the urban public spaces have known considerable upheavals on the formal, physical, functional level, in their uses and practices. The results of these actions have strongly

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influenced the quality and spatial structure of its public spaces, which in turn have negative consequences on the behavior of its occupants.

The spontaneous neighborhoods of the city of Biskra, including El Alia northeast presents dysfunctions in terms of spatial structuring, layout, permeability, orientation, legibility ... etc.in their public spaces.The absence of urban development and the non-existence of street furniture have made it difficult to find one's way around and to identify places in these neighborhoods. These different causes have also made all of the urban public spaces unintelligible, in other words, of poor legibility. These neighborhoods are devoid of urbanity, security and safety. Thus we find ourselves in an urban anonymity with anti-social and aggressive behaviors and urban public spaces unable to ensure the functions that are assigned to them for the needs of the inhabitants.

The public space is essential in the qualification of the urban space affirms Saidouni [1]. The term public space refers to spaces that are accessible to all. Toussaint et al [2]. It must be the place of all mixes, mixes of uses and mixes of population, to allow to stitch a fragmented urban fabric, to reunite heterogeneous spaces, to restore a certain continuity in the urban framework. St. Germain [3]. It is also synonymous with identity and urban quality. The dimensions of public space, contributing to urban design present tangible and intangible attributes of space. Carmona [4], to be a responsive space with qualities of urbanity. Among its attributes are permeability and legibility, which are qualities to be taken into account in the urban design of urban public space, according to the approach of reactive environments. Permeability has an important influence in the good use of space. It is the degree to which a place is accessible to people Bentley [5]. It expresses the capacity of the space to allow easy accessibility by its users.

2. Method and materials

Approaches with methods and tools of analysis are interested in urban design especially in the design of public space and how public places are experienced and used, the method of urban design "responsive environments" of Bentley and that of Space Syntax of Bill Hillier that researchers have often used for modeling.

2.1. Responsive environment

The Bentley Designer's Manual presents an urban design approach, taking into consideration urban structure, permeability, legibility, wayfinding, etc. This method of analysis is based on the perception of man, of his immediate environment. It consists of seven concepts which are the qualities that any urban public space is supposed to have. These seven qualities of Bentley and al reinforce and cover the key issues by making the spaces responsive. These are the qualities of urbanity of urban public space. It is a design process that moves from the most general to the most particular, beginning with permeability, variety, legibility, robustness, visual appropriateness, richness and personalization. [5].

2.2. Space syntax

Spatial syntax is a set of theories and techniques for the analysis of spatial patterns, related to human needs in buildings and cities. It was introduced by Bill Hillier and Julienne Hanson at UCL in the 1980s. It is a "morphological approach within the framework of urban research in the United Kingdom. It uses a methodology comprising several descriptive tools leading to a very sensitive model with the capacity to measure the slightest variations in spatial morphology"[6]. Citing depth, connectivity, control, choice and global and local integration

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www.techniumscience.com

as important measures. The latter is one of the essential measures in the analysis of urban patterns. It is a set of tools developed to describe, explain and interpret spatial social phenomena, summarizing the functioning and dysfunction of urban public spaces such as movement, displacement, crime, feelings of insecurity, etc. [7]. It includes both the local and the global dimension in the urban grid, the local and the global are intrinsically linked, the global is not just an assembly of local parts through hierarchical repetition but a structure that creates these parts. [8].

It presents a whole set of techniques of representations that are significant in relation to behaviors. The technique of axiality is based on a linear definition of space, more appropriate for movement. It expresses spatial accessibility. It allows the evaluation of legibility, especially through the measurement of choice. The axial analysis is the only analysis that allows to have this measure. Whereas the VGA "Visibility Graph Analysis" is defined from a point space. It allows to evaluate the readability and the visual accessibility.

The analysis model is built by combining Bentley's Responsive Environments method [5] and the space syntax method as an analysis tool with the privilege of combining formal rigor and the social nature of urban forms. Hillier and al [8]. Bentley's permeability is translated by accessibility in Hillier. It is modeled essentially by the integration of n-order (global) and n-order 3(local) and models legibility as a quality of urbanity in urban public space by ability to orient itself Hillier's which is indicated by the syntactic measures of global and local order, first and second degree.

3. Presentation of the case of study

The city of Biskra is located in southeastern Algeria (Figure 1), the neighborhood of Alia northeast, our case study, is located in the northeastern part of the ZHUN East of the city of Biskra. This ZHUN which was created in 1979, presents the urban extension of the city of Biskra, beyond the oued Sidi Zarzour on the East side on the site of El Alia. The neighborhood has a peripheral position in relation to the center of the city and its informal settlement pattern gives it a marginal character.

Unstructured neighborhood, no relationship of continuity and coherence with the whole. The existing road system is considered tertiary, except for the existence of two secondary roads that delimit the neighborhood, where the lack of development and hygiene is flagrant. The internal roadway is not directly linked to the different accesses, hence the inexistence of a main road directly accessible from an access, with the exception of the access from the 18th of February Street, which allows a certain legibility, and the access from the street of the Ouarnoughi Brothers.

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
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Figure 1. Situation of the city of Biskra
Source: Atlas Mondial Encarta (2005)

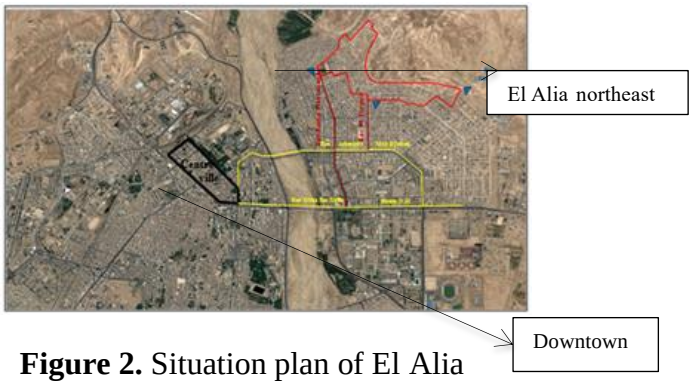

Figure 2. Situation plan of El Alia northeast neighborhood

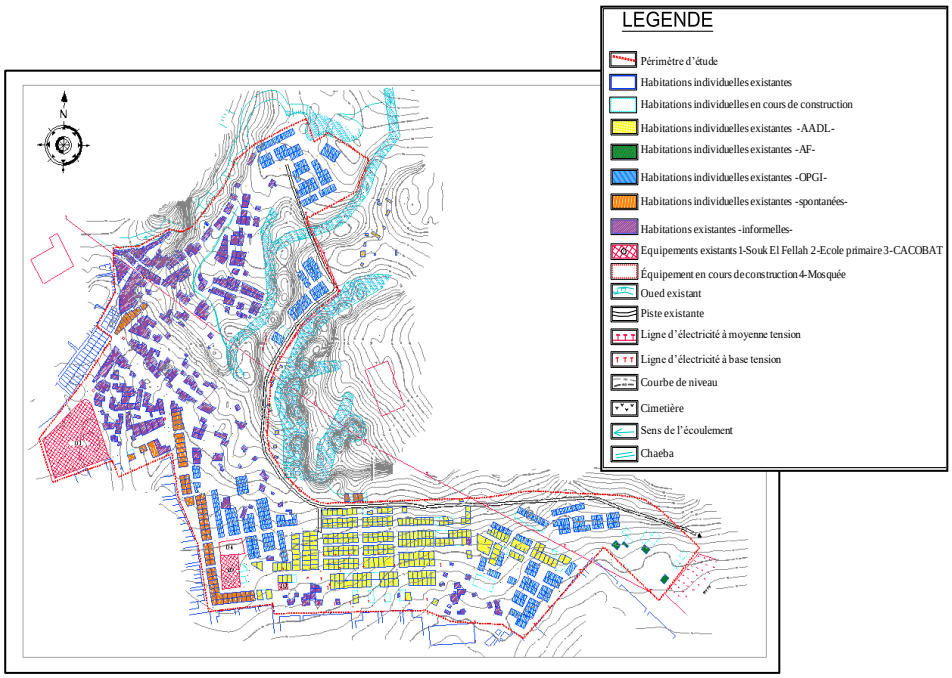

Figure 3. Map of land uses in Alia northeast. Source: Author

Technium Social Sciences Journal
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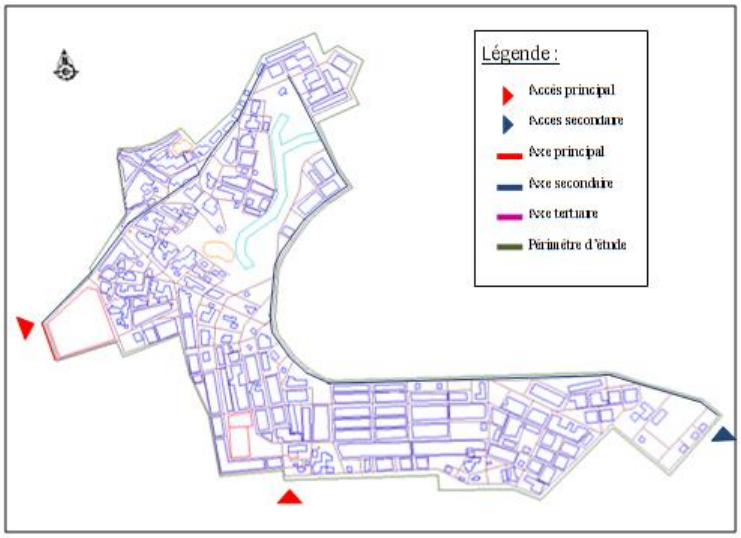

Figure 4. Structuring of the neighborhood's roads. Source : Author

Figure 5. View on the access to the neighborhood by the street of the Brothers Ouarnoughi. Source : Author

Figure 6. View on the access to the neighborhood by the street 18 February. Source : Author

This neighborhood occupies an irregularly shaped parcel (Figure 3), consisting of a set of buildings that delimit the exterior space. These constructions are of different shapes, sizes, gauges, and construction materials. Two different types of urban fabric of individual housing are classified: the first, informal housing, which has been constantly evolving since the 1980s until today. It is produced in an anarchic manner, unstructured, unorganized and is located on the verticality of the western part and the second the planned habitat carried out by companies such as the OPGI and AADL in the years 2000. It is structured and organized but with the absence of any layout plan. It is spread over the horizontal part of the southern part of the neighborhood.

The urban public spaces in this spontaneous neighborhood are produced as residual spaces of built forms. The absence of urban amenities and the non-existence of street furniture have made it difficult to find one's way around and to identify places. No legible form of a hierarchy of urban public spaces or even of the notion of street, alley, dead end, square...etc. especially in the western part of the neighborhood. The road structure seems to be very difficult to orientate oneself and to identify places, especially for people who are visiting the district for the first time. There is a risk of getting lost and finding oneself in insecure spaces that are not legible or accessible.

Technium Social Sciences Journal
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The facilities, despite their importance to meet the needs of the inhabitants, are almost non-existent: elementary school, an administrative facility, a mosque and the Souk, nowadays not functional, however, the inhabitants have appropriated the sidewalks of the street the Brothers Ouarnoughi in an informal way giving thus a marker to the western access of the neighborhood. This lack of facilities and services has a negative impact on the daily life of the inhabitants and makes the whole neighborhood segregated.

These different causes have made all the spaces poorly legible and difficult to access. These neighborhoods are devoid of urbanity and security. They are therefore in an urban anonymity.

Figure 7. Spontaneous housing (El Alia Nord-Est). Ambiguous urban structure. Source : Author

Figure 8. Absence of meeting places, play areas (children and adults) and urban furniture. Source : Author

Figure 9. Sidewalk not suitable for pedestrian traffic. Source : Author

Figure 10. Unsuitable for mechanical and pedestrian traffic. Orientation and identification are very difficult. Source : Author

Figure 11. Absence of the notion of urban public space. Source : Author

Figure 12. Deserted street total absence of commercial and service activities. Source: Author

Technium Social Sciences Journal
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www.techniumscience.com

Following an exhaustive analysis of the neighborhood, many anomalies in the viary structure and the habitat type were detected. To remedy this, the Office of Studies and Achievements in Town Planning (U.R.B.A) was commissioned in 2006 to produce a Land Use Plan (P.O.S.) specific to the neighborhood which carries an urban planning taking into account the viary structure, type housing and the proposal of new equipment. The latter was selected in 2011, whose plan is shown in the figure below.

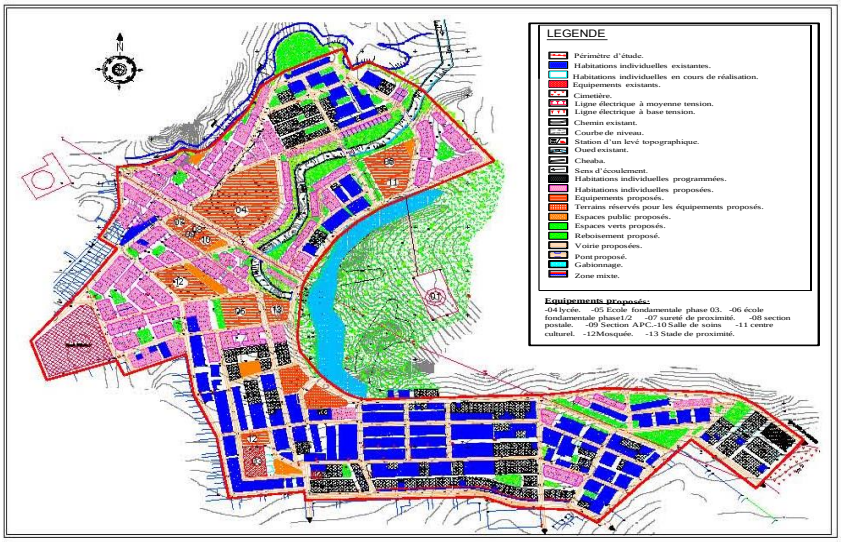


Figure 13. Proposed and retained layout plan for El-Alia North-East neighborhood

The application of spatial syntax on the plan of the neighborhood of El Alia northeast in the current situation and the proposed layout plan, allowed us to make the reading and analysis of the following comparative syntax study:

4. Results and discussion

4.1. *Results of the Visibility Graph analysis "VGA"*

4.1.1. First degree measures

Reading the graph for the measurement of visual connectivity shows that the highest values are those of the area to the east of the system with the red color, while in the proposed plan the maximum values found in the urban space correspond to the structuring axis proposed by URBA, which crosses the neighborhood from west to east. While the least connected spaces have minimal values of connectivity, are found between the constructions in the whole system by the presence of the blue color. The interpretation is considered by the limited number of axes that connect it with the system. These are the spaces that do not have a direct relationship with the connected spaces. It seems that the layout proposed by URBA is only the result of a design by part. The overall scale is not taken into account.

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
ISSN: 2668-7798
www.techniumscience.com

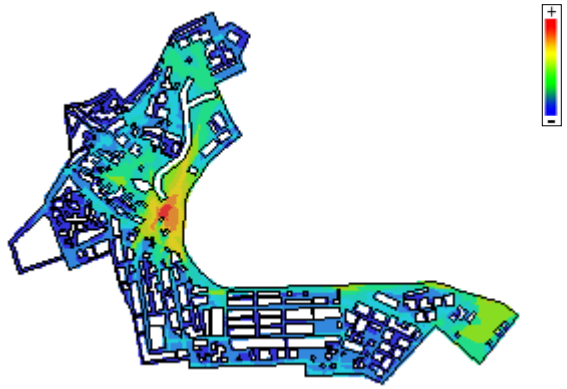
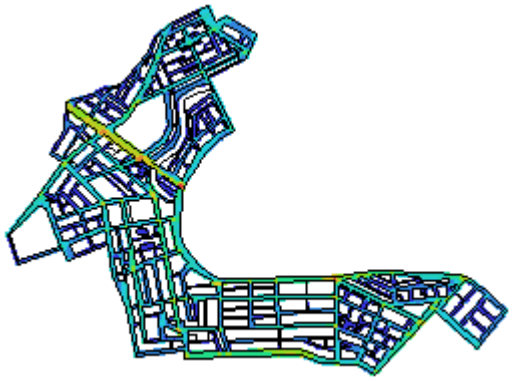
	Map of El Alia North-East neighborhood: Current situation	Map of El Alia North-East neighborhood: Proposed layout
" VGA" Analysis		

Figure 14. Results of the" VGA" analysis for the connectivity measure. Source : Author

In the current situation, for the "VGA" analysis and for the measure of global integration, the layout (AADL, OPGI, spontaneous) has not been able to polarize all around, hence the centrality remains off-center. Similarly, the layout proposed and programmed by URBA (AADL, OPGI, spontaneous, informal) has not been able to create an integrated road system, so that the centrality always remains off-center, leaving the other parts of the system segregated, particularly the northern, southeastern and western parts. The spaces between the constructions seem to be considered as segregated spaces. These spaces cannot be perceived from the most integrated spaces.

Overall, there is an integrated structure to the central part of the neighborhood either in the current situation, or in the proposed development plan, leaving the other parts of the neighborhood segregated.

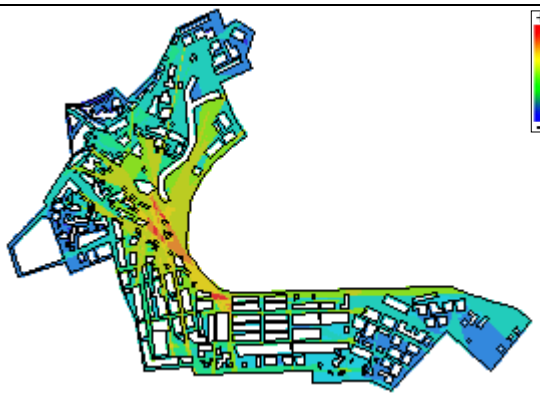
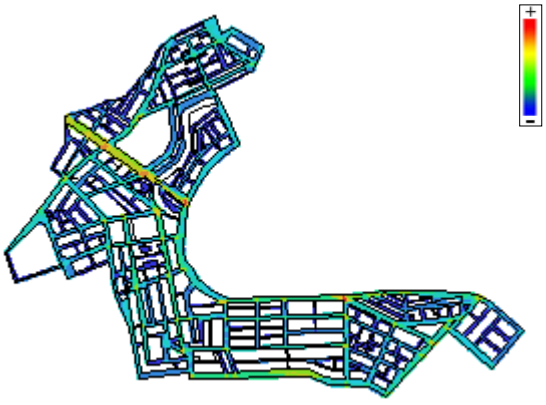
	Map of El Alia North-East neighborhood: Current situation	Map of El Alia North-East neighborhood: Proposed layout
" VGA" Analysis		

Figure 15. Results of the " VGA" analysis for the global integration measure. Source : Author

In the current situation, the VGA analysis shows some emergence of local centrality for the OPGI space (in the north and southeast pole) and even for the informal space (in the west). However, the AADL area (to the south) is completely disconnected and forms no local

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
ISSN: 2668-7798
www.techniumscience.com

centrality. In the proposed layout, the system shows some emergence of local centralities for the OPGI space (at the north and southeast pole) and even for the space between the proposed individual dwellings (at the west) and the AADL part (at the south). The spaces integrated at the local level are generating movement, some are the places intended for this purpose (for example, the structuring axis surrounded by the equipments) while the streets serving the proposed green and public spaces remain segregated.

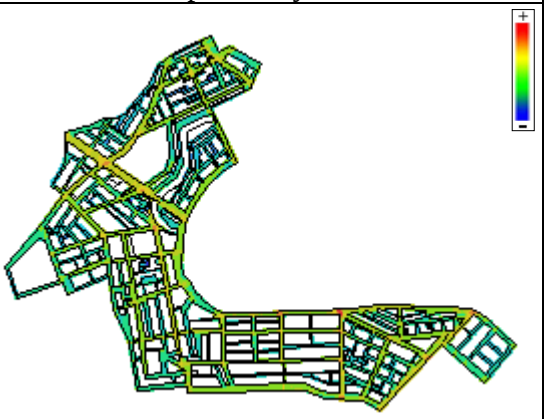
	Map of El Alia North-East neighborhood: Current situation	Map of El Alia North-East neighborhood: Proposed layout
" VGA" Analysis		

Figure 16. Results of the" VGA" analysis for the measurement of local integration. Source : Author

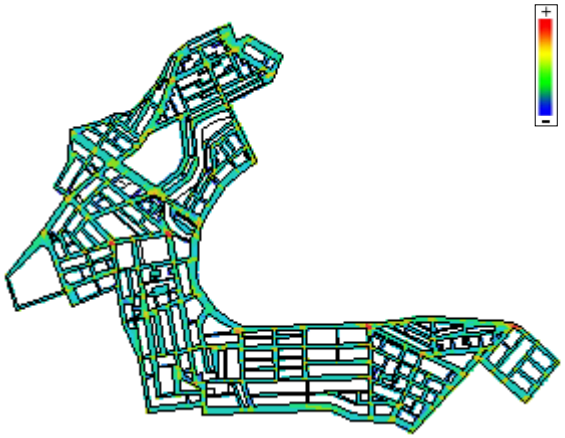
	Map of El Alia North-East neighborhood: Current situation	Map of El Alia North-East neighborhood: Proposed layout
" VGA" Analysis		

Figure 17. Results of the" VGA" analysis for the measurement of Control. Source : Author

Reading the results of the VGA analysis shows that the control spaces of the whole system are locally scattered. Each fabric has its own control points. The value of control increases at street crossings (1.64). Each intersection represents a control point where a passenger will have a choice of other spaces to move through. The spaces between buildings in this system have very low control (0.19).The public spaces with the highest local visual integration values are the public spaces with the highest control values.

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
ISSN: 2668-7798
www.techniumscience.com

4.1.2. Second degree measure

4.1.2.1. *Intelligibility*

The VGA analysis shows a rather low correlation between local (connectivity) and global (integration) values. The intelligibility plot shows a very low correlation coefficient (R2= 0.33 and R2= 0.41). This is a non-intelligible system. The whole system does not become legible from its constituent parts. The weakness is due to the visible spaces that are more globally integrated than locally connected. Connectivity is no longer an indicator of integration. The axes are much more integrated than connected. This affects the experience of first-time visitors to the neighborhood. It is a system in which orientation and visual accessibility are difficult.

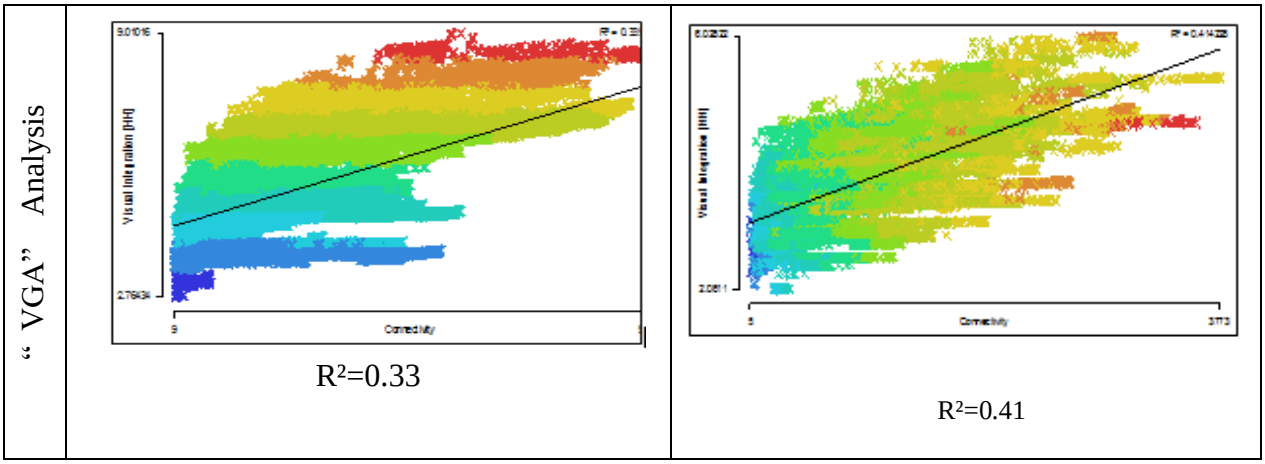


Figure 18. Graph of intelligibility by"VGA" analysis. Source: Author

4.2. Axial map analysis results

4.2. 1. First degree measures

The connectivity graph through the axial analysis shows three axes of important connectivity values. The spaces that are least connected are at the North Pole, west and south-east, south of the neighborhood and between the constructions. We can detect that the connected areas have not changed. The central part remains the most connected for the plan of the current situation and the proposed layout (Fig. 2).

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
ISSN: 2668-7798
www.techniumscience.com

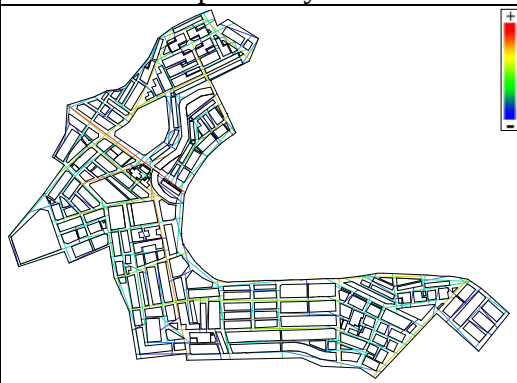
	Map of El Alia North-East neighborhood: Current situation	Map of El Alia North-East neighborhood: Proposed layout
Axial Analysis		

Figure 19. Results of the axial analysis for connectivity measurement. Source : Author

The axial map of global integration shows an integrated structure (red color) at the central part in relation to the neighborhood with a very integrated extension to the south and another to the north. In reality, the latter is a busy shortcut, while the former is the tertiary axis that extends from the center to the busy 18 February Street access. Similarly for the proposed layout, the most integrated axes are located in the center of the neighborhood, two are very structuring, the first of which is an extension to the south and the second northwest, thee proposed structuring axis, leaving the other parts of the system in segregation (blue color), including the north, southeast, south and west. The integrated road network of the system is not connected to the integrated road network of the city. The most integrated axes appear to be more easily accessible, permeable and visible than the segregated axes (minimum values).

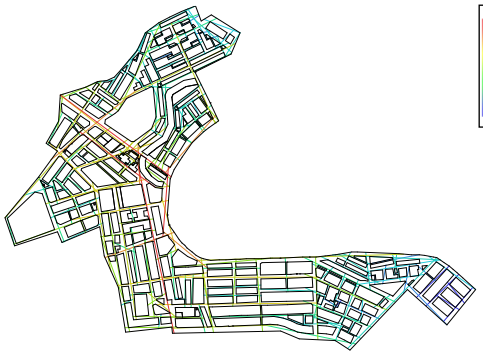
	Map of El Alia North-East neighborhood: Current situation	Map of El Alia North-East neighborhood: Proposed layout
Axial Analysis		

Figure 20. Results of the axial analysis for the global integration measure. Source : Author

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
ISSN: 2668-7798
www.techniumscience.com

The results of the graph of the local integration measure, in the plan of the current situation, show the presence of a centrality but which remains punctual and does not extend to the surroundings of the neighborhood leaving the other parts of the spaces in segregation. There is no emergence of secondary centralities. However, in the proposed layout plan, secondary centralities appear with strong integration axes. Thus, the residential areas appear to be connected to the center by a continuous structure.
There are also axes with segregated values that correspond to the periphery of the southeast pole and to the spaces between the buildings, the north pole, the west and the south. These spaces are more integrated into their local than their global environment

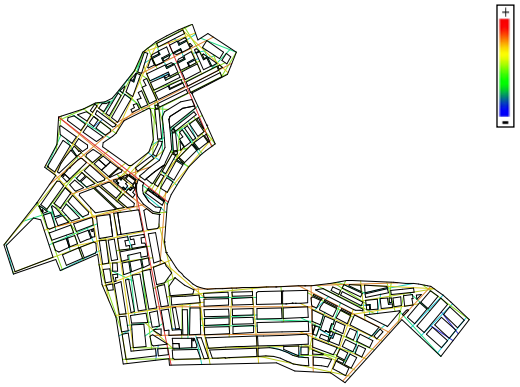
	Map of El Alia North-East neighborhood: Current situation	*Map of El Alia North-East neighborhood: Proposed layout*
Axial Analysis		

Figure 21. Results of the axial analysis for the measurement of local integration. Source : Author

Examining the graph of the control map, we find a control axis with a control value of (3.40). We find an axis with an important value of control (2.68) coincides with the axis that connects the neighborhood to the access of 18 February Street. These two axes also correspond to the most connected and integrated axes globally and locally. The spaces on the periphery and between the buildings are spaces with low values of control (0.58 to 1.00).

The measure of control tells us the ideal path, which a user can take; we can say that, in the plan of the current situation, the neighborhood does not have enough spaces and axes of control. Strangers are rare and we only find the inhabitants who know precisely these spaces. In contrast, in the proposed layout plan, the spaces and axes of control are multiplied. Strangers will be much more likely to use these spaces. Urban public spaces will be more legible than in their current state.

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
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www.techniumscience.com

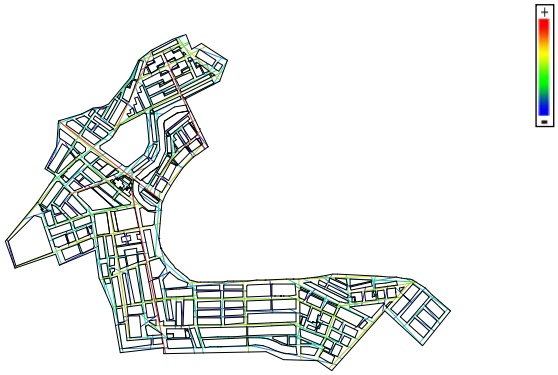
	Map of El Alia North-East neighborhood: Current situation	Map of El Alia North-East neighborhood: Proposed layout
Axial Analysis		

Figure 22. Results of the axial analysis for the measure of control. Source: Author

The reading of the graph of the measure of choice shows, in the neighborhood of El Alia northeast, two structuring axes, which have very high values of choice. The axis representing the shortcut that extends from the center to the north and south-west (where the spontaneous habitat) and the axis whose extension from the center of the neighborhood to the access to the south of the street 18 February. While in the proposed development plan, it is this last axis that remains with the highest of the choice values, leaving the rest of the axes with low choices. The urban fabrics represent a significant number of low choice axes. It appears that this does not facilitate location and orientation and makes legibility difficult.

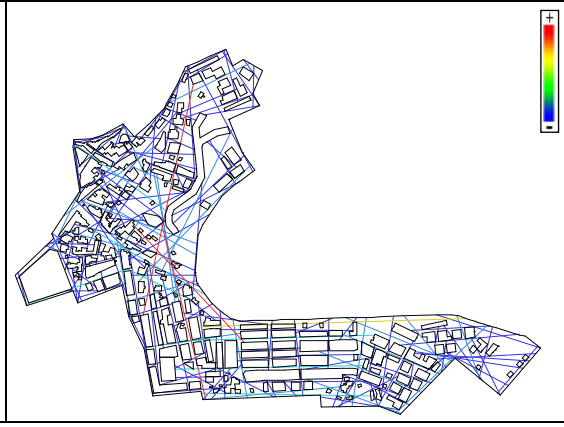
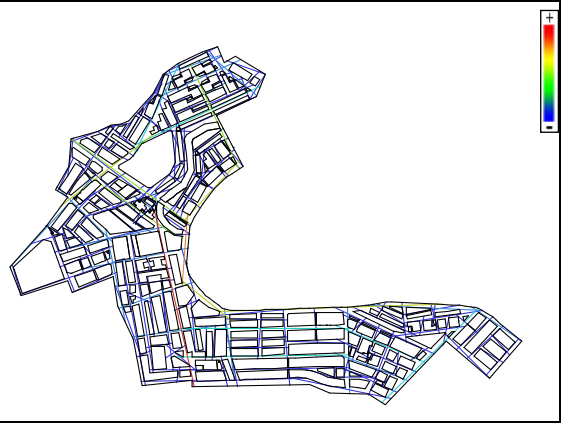
	Map of El Alia North-East neighborhood: Current situation	*Map of El Alia North-East neighborhood: Proposed layout*
Axial Analysis		

Figure 23. Results of the axial analysis for the measure of choice. Source: Author

4.2. 2. Second degree measures

4.2. 2. 1. Intelligibility

This diagram of intelligibility shows a scattered scatter plot with a low correlation coefficient between global integration and connectivity (R^2= 0.54 and R^2= 0.38). This indicates that the

Technium Social Sciences Journal
Vol. 39, 554-568, January, 2023
ISSN: 2668-7798
www.techniumscience.com

system considers itself unintelligible. It is therefore clear that well-connected public spaces (local scale) are not well-integrated spaces (global scale) and that connectivity is no longer an indicator of integration. It does not have an integrated global dimension, that is to say linked by axes that are integrated into the viary structure of the urban system. It is a system in which orientation and accessibility are difficult.

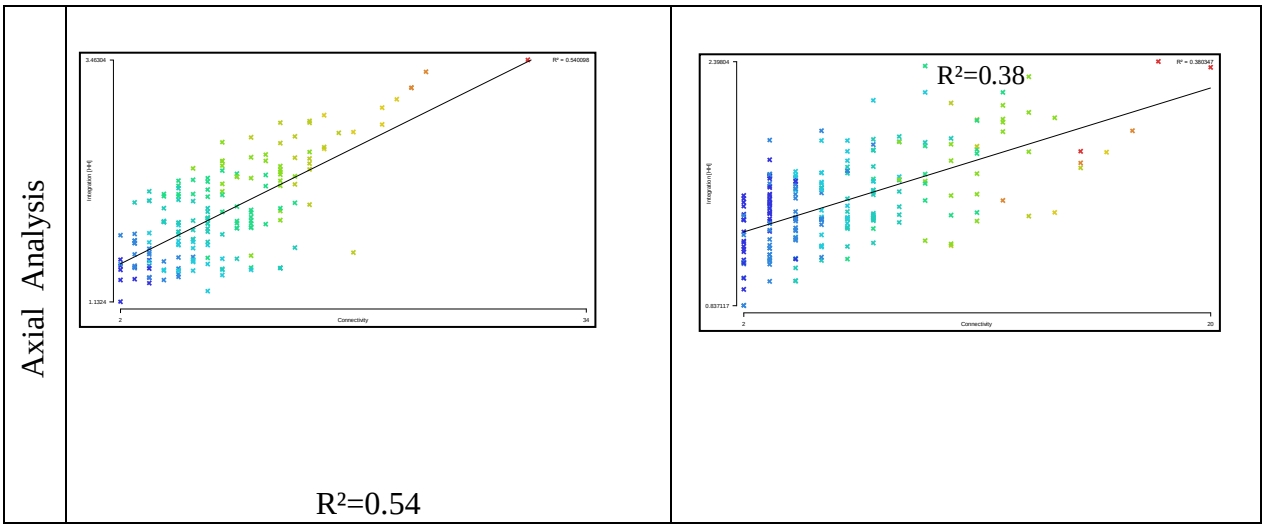


Figure 24. Graph of intelligibility by axial analysis. Source: Author

5. Conclusion

The comparison between the results of the application of spatial syntax on the plan of the neighborhood of El Alia North-East in the current situation and the proposed development plan, allowed us to conclude that it is a plan designed in one dimension, the result of a design by part. The overall scale is not taken into account and the existence of an integrated structure in the central part of the neighborhood leaving all other parts of the neighborhood in segregation. It is a non-intelligible system. It is not permeable and illegibility.

The design of the Office of Studies and Achievements in Town Planning (URBA) for the neighborhood of El Alia North-East has not been able to create an intelligible system where the well-connected spaces are also well integrated. As a result, the spatial structure is illegible, as orientation and accessibility are difficult. The global and local dimensions hardly coincide in a common dynamic.

This syntactic study based on the values of the first degree: connectivity, global and local integration, control and choice and the second degree intelligibility shows that the spatial structure is influenced both at the local and global scale. It targets dysfunctions in urban public spaces and then allows for their remediation in order to have functional spaces with good urban qualities such as permeability and legibility.

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