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A STUDY OF THE MORPHOLOGICAL EVOLUTION OF THE URBAN CORES OF BAGHDAD IN THE 19TH AND 20TH CENTURY

DHIRGHAM ALOBAYDI

The University of Kansas, Lawrence, United States
dalobaydi@ku.edu

MAHBUB RASHID

The University of Kansas, Lawrence, United States
mrashid@ku.edu

ABSTRACT

The urban development processes of Baghdad witnessed important phases of modernization, as evident in its evolving urban grids. By the early period of the 19th century, an organic grid of its main historic core emerged with a grid system applied by the colonial power to control and guide the urban growth along the course of the River Tigris. In the late of 1950s, the first rectilinear grid street patterns were adopted to manage the new expansion along the northwest-southeast axis, and suburbs were introduced characterizing faster growth at urban edges. Throughout this modern evolution, many planning practices were applied that pushed urban growth in all directions, ultimately forming a much bigger city around the historic urban core of Baghdad. In the 2000s, the size of the metropolitan city has become huge with various patterns of urban grids, producing a high sense of spatial complexity.

The main purpose of this paper is to study the syntactic properties of the spatial urban cores of Baghdad in the 19th and 20th century by using space syntax techniques and measures. The paper analysed six historical phases of the city - 1900s, 1920s, 1940s, 1960s, 1980s, and 2000s - showing significant changes in the urban grid. Two key measures, integration and choice, of space syntax were adopted to identify the syntactic typologies of urban cores. Major distinguishing patterns, which generally tend to interact with growth trends of the built environment, for each phase were identified.

Findings show that there have been significant changes in the typologies and locations of syntactic urban cores from one historic phase to another of the city. Some of the identified patterns undermined the common notion of the inevitable correlation between commercial activities and integration cores, and appeared more interactive with planning practices influencing the density and direction of urban growth. Future research study should include the evolution of the morphology of the city since its inception in the 7th century CE; and should apply the same approach on a limited scale to other urban units, such as districts and neighbourhoods.

KEYWORDS

Space syntax, syntactic properties, urban cores, modernization, Baghdad

1. BACKGROUND

Despite a commonly accepted understanding of the complexity of cities, many Middle Eastern cities appear to be more complex than other cities due to the path of emergence and growth peculiar to these cities. Like many other organic cities, they developed in response to topography, climate, and societal needs (Elsheshtawy 2004, Hakim 2013). The organic patterns

of these cities were often characterized by narrow zigzag roads and cul-de-sacs, compact urban clusters, low-rise buildings, small urban blocks, and a mixture of land uses. They lack the basic properties of modern urban planning, such as repetition, symmetry, rhythm, and alignment (Alobaydi and Rashid 2015, Hakim 2007).

After hundreds of years of organic development, the infrastructures of these Middle Eastern cities were reformed using modern planning practices, carried out by the European colonial powers in the early 19th century (Al-Ashab 1974). These modern practices included, but were not limited to, the use of an orthogonal layout, highway systems, superblocks, and zoning aimed to control and manage the physical, social, and economic resources of these cities. For example, several master plans based on the modern planning principles were prepared for the development of the City of Baghdad. The most important ones were applied between the 1900s and the mid- 1960s restructuring the city form of Baghdad (Elsheshtawy 2004, Pieri 2008). As a result, a combination of organic and grid patterns had developed throughout the British Mandate and Iraq Monarchy. However, with the emerging interest in the legitimacy of the National Republican Rule of Iraq during the late periods of 1950s, the patterns were modified and infused with rigid rectilinear forms, as the automobile became a primary mode of transportation. The rectilinear forms extended over a vast area beyond the old historic core of the city. By the 1980s, main boulevards and highway systems have isolated the organic historic nuclei, including Old Baghdad, al-Kadhimiya, and al-Adhamiyah, from the whole network system of the city. The rapid growth of the city helped decrease the urban density of the historic core by increasing it at the urban edges. Now, in the 2000s, the size of the metropolitan city has become huge, and it contains various patterns of urban grids creating a high sense of spatial complexity (Alobaydi and Rashid 2015). For an illustration of the important planning features of Baghdad in the 2000s see (Figure 1).

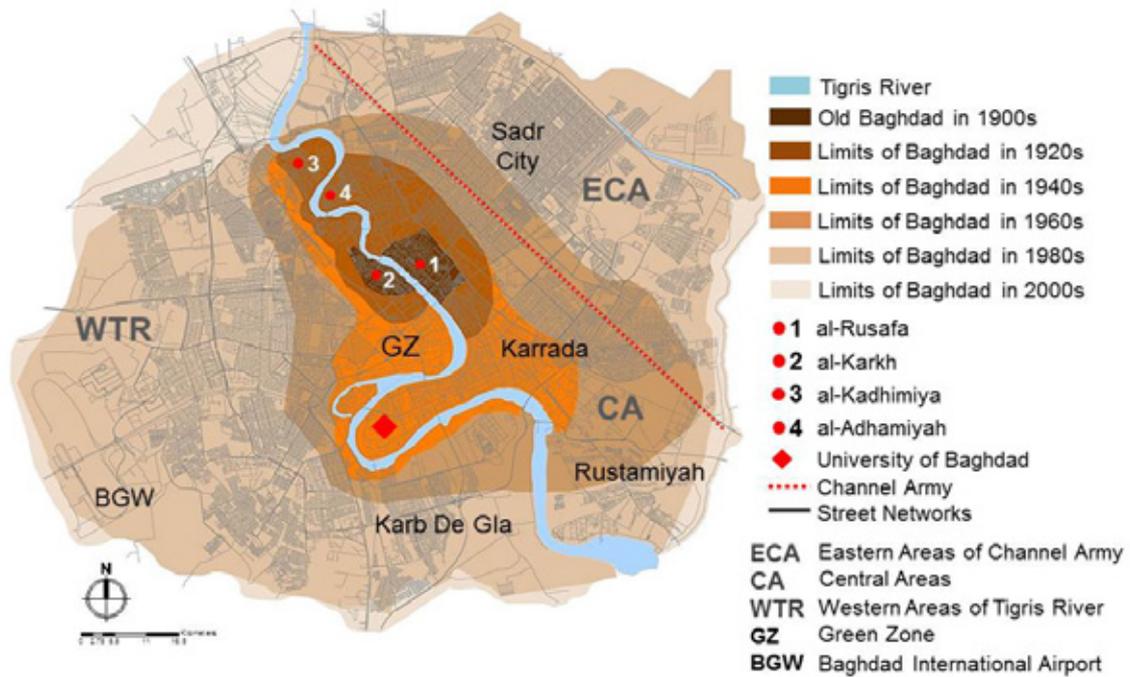


Figure 1 - The map shows the main planning features and historical morphological phases of Baghdad

Past research evaluating the development of syntactic urban cores in the Middle East region has been limited at the scale of historic nuclei. A review of the existing literature found many studies that cover many issues such as socio-economic influences, landmark spatialization, movement

densities, and modern planning implications (Asami et al. 2003, Griffiths 2009, Griffiths et al. 2010, Karimi 2012, Rashid and Alobaydi 2015, Rashid and Bindajam 2015). However, they do not sufficiently illustrate the morphological variations of the syntactic urban cores of a typical Middle Eastern city. So far, studies involving syntactic measures, such as integration and choice, show that the prevalent structural properties of urban cores formed during historical phases of modernization often cluster beside and around socio-commercial activities of Baghdad (Alobaydi and Rashid 2015). During the last two phases, however, these cores might have interacted more with modern planning practices to manage the density, pattern, and direction of the growth of this city. Therefore, the purpose of this study was to explore the effects of modern planning practices on the evolving urban core of Baghdad. More specifically, it would like to explore, how were the syntactic urban cores changed from one phase to another due to modern planning practices, and how can these changes be described and classified?

2. METHODOLOGY

For its purpose, the study uses space syntax approach, which was founded by Hillier and his colleagues (Hiller 1984, 2007). Two common measures of space syntax, integration and choice, were chosen here to analyse, identify and describe the development of urban cores in several historical phases of Baghdad. For each phase, the study consists of three main parts: first, it describes the spatial framework of the city based on land use distribution; then, it identifies the integration and choice cores found in these phases; and, finally, it visually correlates the identified patterns of syntactic urban cores to land use activities and/or different planning practices. Therefore, the space syntax approach is discussed in detail in the next section.

2.1. SPACE SYNTAX APPROACH

Space syntax is a set of theories, techniques, and measures for studying the syntactic properties of the configurations of streets structures and open spaces. One of the most important techniques of space syntax is the axial map, which has been applied to study spatial layouts at different scales, ranging from a single building to an entire city. Another more recent space syntax technique is the segment map, which is formed by breaking down each axial line at the intersections with other lines. Using the techniques and measures of the axial and segment map analysis, many researchers have demonstrated how the accessibility and connectivity of spaces can be used to explain observable social phenomena including socio-economic patterns, movement density, and land use distributions (Griffiths 2009, Hanson 1989, Hillier 2005, Hillier 2007, Hillier et al. 1987, Peponis et al. 1989, Rashid and Alobaydi 2015, Rashid and Shateh 2012, Rashid and Bindajam 2015).

As noted above, this study used the integration and choice measures of space syntax, which are described below.

- **Integration measure**

One of the most common measures of space syntax is the integration, which indicates how accessible/connected a line is in relation to all the other lines in the map. Therefore, high integration values indicate lines that have better connections while low values refer to lines that have fewer connections with the other lines. The integrated values are represented graphically on the map using a scale of colours that range from red referring to highly integrated streets, to blue referring to the segregated streets.

Integration values can be computed at different radii. For example, the integration value at radius-3 of a line uses only those lines that are three steps away for the given line; the integration value at radius-5 uses only those lines that are five steps away for the given line; the integration value at radius-7 uses only those lines that are seven steps away for the given line; and so on. The integration value at radius-n of a line considers the n-steps needed to cover all the lines in the whole system (Hillier 2005, 2007). Therefore, the integration value computed at a lower radius describes a more local syntactic property than that computed at a higher radius. Note, however, that the most local of any syntactic property of a line is its

connectivity value, which is the number of lines directly connected to the line.

Integration Core: It is often defined by the most integrated 10% of all the streets in a network of streets. The segregation core, in contrast, refers to the least integrated 10% of all the streets in a network of streets, and is often located in and around less accessible places (Hillier et al. 1987).

- **Choice measure**

The other key measure of space syntax utilized in this study is choice. Unlike integration, choice gives the degree to which a line lies on the simplest paths from one line to another line in the network. The choice value of a given axial line is determined by dividing the number of shortest paths between any two lines in the axial map containing the given line by all the shortest paths between any two lines in the map (Turner 2007).

In simple terms, integration measures how easy it is to go from one line to all the other lines of a network, thus indicating the potential of a line for to-movement. In contrast, choice measures indicate how likely it is for a line to be chosen on the potential paths from one line to another in a network and thereby indicating its potential for through-movement (Hillier 2005). Clearly, what is implied here is that users want to maximize their accessibility to all physical spaces by to-movements and to minimize efforts by through-movements from one space to other spaces.

Choice Core: It is often defined by the 10% of all the streets in a network of streets with choice values higher than the rest. The core with least choice, in contrast, is defined by the 10 % of all the streets in a network of streets with choice values lower than the rest (Hillier et al. 1987).

2.2. DATA COLLECTION AND METHODS

The data included the maps of Baghdad representing the early period of the last century up to the present stage of the city. The majority of the old maps were drawn by Western geographers and explorers who visited Baghdad before and after WWI (Al-Ashab 1974). For this paper, the six historic maps representing the 1900s, 1920s, 1940s, 1960s, 1980s, and the 2000s were collected and integrated to identify the most important phases of modernization of the city.

The sources for the used maps included Al-Ashab (1974), Municipality of Baghdad, the Centre of Urban and Regional Planning at the University of Baghdad (CURP-BU), the Central Library at BU, the Ministry of Planning in Iraq, the Watson Library at the University of Kansas (KU), and the Libraries of the University of Texas (UT) at Austin. Between the 1970s and the 2000s, information pertaining to the urban forms of Baghdad was rare because of the security restrictions imposed by the al-Ba'ath government. Therefore, a recent satellite image (2008) provided by CURP-BU was integrated and used to study the current phase of Baghdad.

While Baghdad in the 1900s experienced organic developments in and around the historic urban core, the next two phases in the 1920s and 1940s reflect planning practices that were used by the colonial government in power and the Iraqi Kingdom through the Iraqi Development Board (IDB), or Majlis al-A'mar (Pieri 2008). Different sets of modern planning practices and norms were applied to manage city development and extension during the 1960s and 1980s. Rapid urban development from the al-Ba'ath regime (1968-2003) up to the present also used many modern planning models that accelerated the expansion of grid patterns, particularly in suburbs and urban edges. Urban explosion is the best term to describe the current phase of Baghdad (after 2003) because of unprecedented urban sprawl (Alobaydi and Rashid 2015).

2.3. PREPARING AND DIGITIZING DATA

Due to the cartographic differences between the satellite image and the scanned old maps, first georeferencing, which is the process of assigning spatial coordinates to the used maps, was applied. In the georeferencing operation, important landmarks and streets that have not changed from one phase to another were used. It should be noted that some parts of these

scanned maps, particularly in the urban edges, did not entirely match each other due to the inherent differences in the map-making methods used, which became a limitation for this study. For each map representing a historical phase, the axial and segment maps were created using space syntax techniques to represent the spatial configurations of urban cores.

2.4. STUDIED SCALES

Because the city form has changed significantly over time, the size of the examined areas also increased from one phase to the next. The first historical phase (1900s) was located inside the limits of Old Baghdad (al-Rusafa and al-Karkh) (Figure 1), and had a measured area of 6.5 sq. kilometres (2.5 sq. miles). The second historical phase had a measured area of 34.7 sq. kilometres (13.4 sq. miles). The third development phase (1940s) had an area of 47 sq. kilometres (18.2 sq. miles). The fourth development phase (1960s) had an area of 65.7 sq. kilometres (25.4 sq. miles). The fifth development phase (1980s) had an area of 314.2 sq. kilometres (121.3 sq. miles). For the last phase, the metropolitan city of Baghdad measured 379 sq. kilometres (146.3 sq. miles).

3. RESULTS AND DISCUSSION

Results and discussions for each identified pattern focus on linking the syntactic urban cores defined using the integration and choice values with land use patterns and planning practices to identify the urban density and growth trends in Baghdad. The identified patterns found in the historical phases of modernization in the city since the early 20th century can be described as follows:

3.1. TREE AND LINEAR PATTERNS

The tree patterns of integration and choice cores are found in the axial and segment maps of the first phase of Baghdad's map. These cores were formed on the al-Rusafa side where the building density had increased significantly during this phase. In 1900s, Baghdad was generally held to be the archetypical organic city in the Arab-Islamic environment. Built by the influences of socio-cultural traditions and economic processes without the preplanned design, the city contained dense and overcrowded clusters, short irregular blocks, zigzag network-roads, cul-de-sacs within huge boundary walls and gates (Al-Ashab 1974, Elsheshtawy 2004). Unlike institutional and commercial areas, residential clusters were overcrowded with a full coverage of sites by building forms. The growth was concentrated in and around the institutional and commercial centres in al-Rusafa, while the urban development in al-Karkh was less crowded and characterized by long winding streets and blocks as well as a low coverage of sites by building forms (Alobaydi and Rashid 2015). In addition, irregular roads and lanes were distributed outside the limits of Old Baghdad in line with the course of the river for use by farmers (who controlled large chunk of lands outside the city) and traders, who had often participated with local inhabitants in seasonal trading activities at the main gates of the city.

- *Integration core:* As shown in the figure, the integration core of the axial map of the first phase of Baghdad formed a tree pattern. The core was located in the al-Rusafa side. With the exception of the old bridge on the Tigris River, streets with a high value of accessibility were longer streets in denser organic historic clusters. Major institutional and commercial centres of Baghdad were located along these streets. The segregated areas included the peripheral roads at the perimeters of the city wall in al-Rusafa and al-Karkh sides. (Figure 2)
- *Choice core:* Unlike the integration core, the choice core of the segment map formed a linear pattern. The choice core is represented by the main bridge that connected the two main sides of the city, al-Rusafa and al-Karkh. In addition, most of other streets with high choice values were located in the al-Rusafa side. The segment map also indicates that streets with high choice values were also the streets with high integration values. (Figure 2)

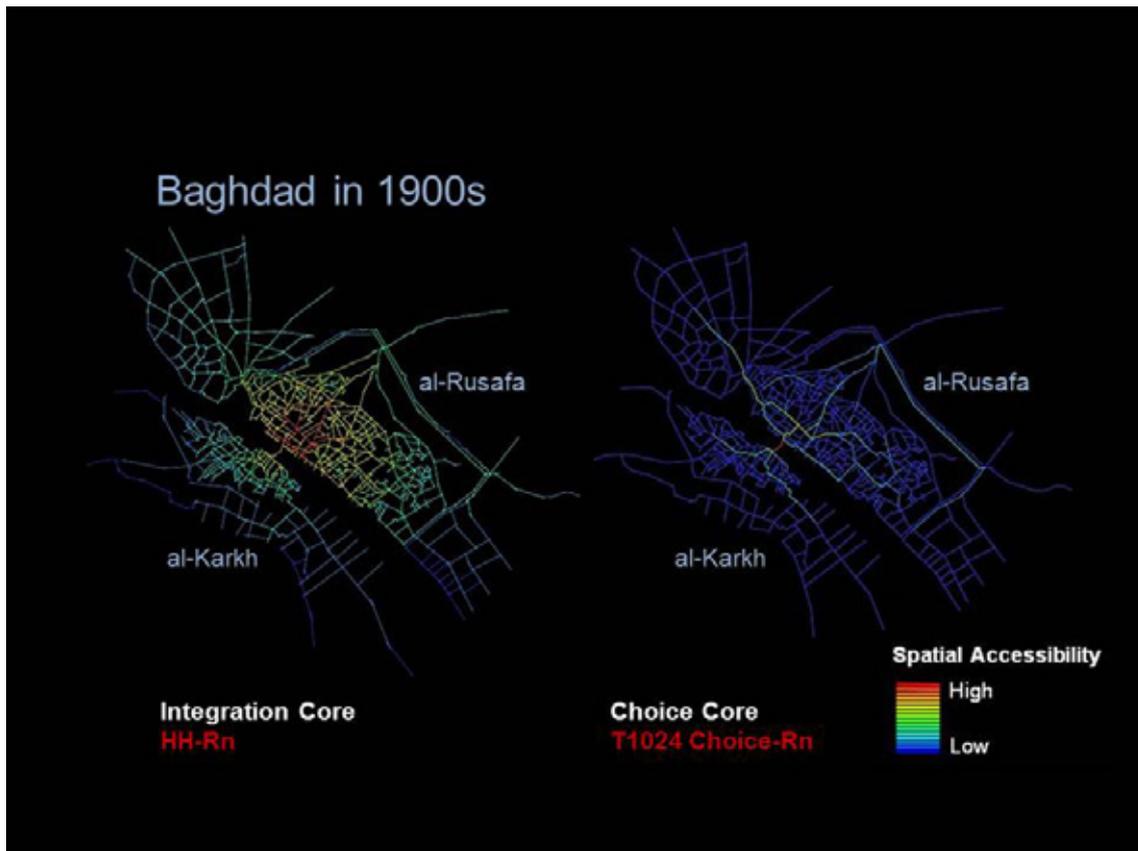


Figure 2 - the maps of Baghdad syntactic urban cores in 1900s

3.2. SUPERGRID AND LINEAR PATTERNS

The supergrid configurational pattern of integration and choice cores is considered as a main feature of the second and third study phases (1920s and 1940s) of the city of Baghdad (see Figure 3). The supergrid in these phases was formed by a set of orthogonal streets, founded by the British Colonial power. This pattern was concentrated in the al-Rusafa side, which already had a dense pattern of everyday interaction, transaction, and encounter (Al-Ashab 1974). Under the rule of the Iraqi Monarchy and the British Mandate, more changes were made to the city by Western architects and planners, using gridded streets, railways, rectangular plots, land use zoning, and concrete buildings (Pieri 2008). These changes helped to form the aforementioned supergrid. This supergrid primarily was formed to control and manage the movement of pedestrians and automobiles within the historic organic residential fabrics characterized by zigzag roads, alleys, and cul-de-sacs. Many institutional, commercial, and mixed-use activities were located along the streets forming the grid. These streets were laid out and distributed in a way that helped to guide the growth of the city in line with the river, from the northwest to the southeast direction.

- *Integration core:* The axial maps of the second and third historical phases of Baghdad show streets with high integration values forming a supergrid pattern (Figure 3). The majority of integrated streets were located in al-Rusafa. In addition to that, the two bridges (including Shuhada and Ahrar) that connected the al-Rusafa and al-Karkh sides also appeared as integrated paths in the supergrid. The segregated core, however, was divided into two areas: first, in al-Kadhimiya where various sets of short and mid-length irregular streets and lanes were distributed in a scattered manner in and around organic historic clusters. Second, a set of long winding streets were distributed in the Karrada quarter located in the southwest of Old Baghdad. Segregated lines were also distributed in the peripheral large agricultural areas on the southwest and southeast side of Old Baghdad. (see Figure 1)

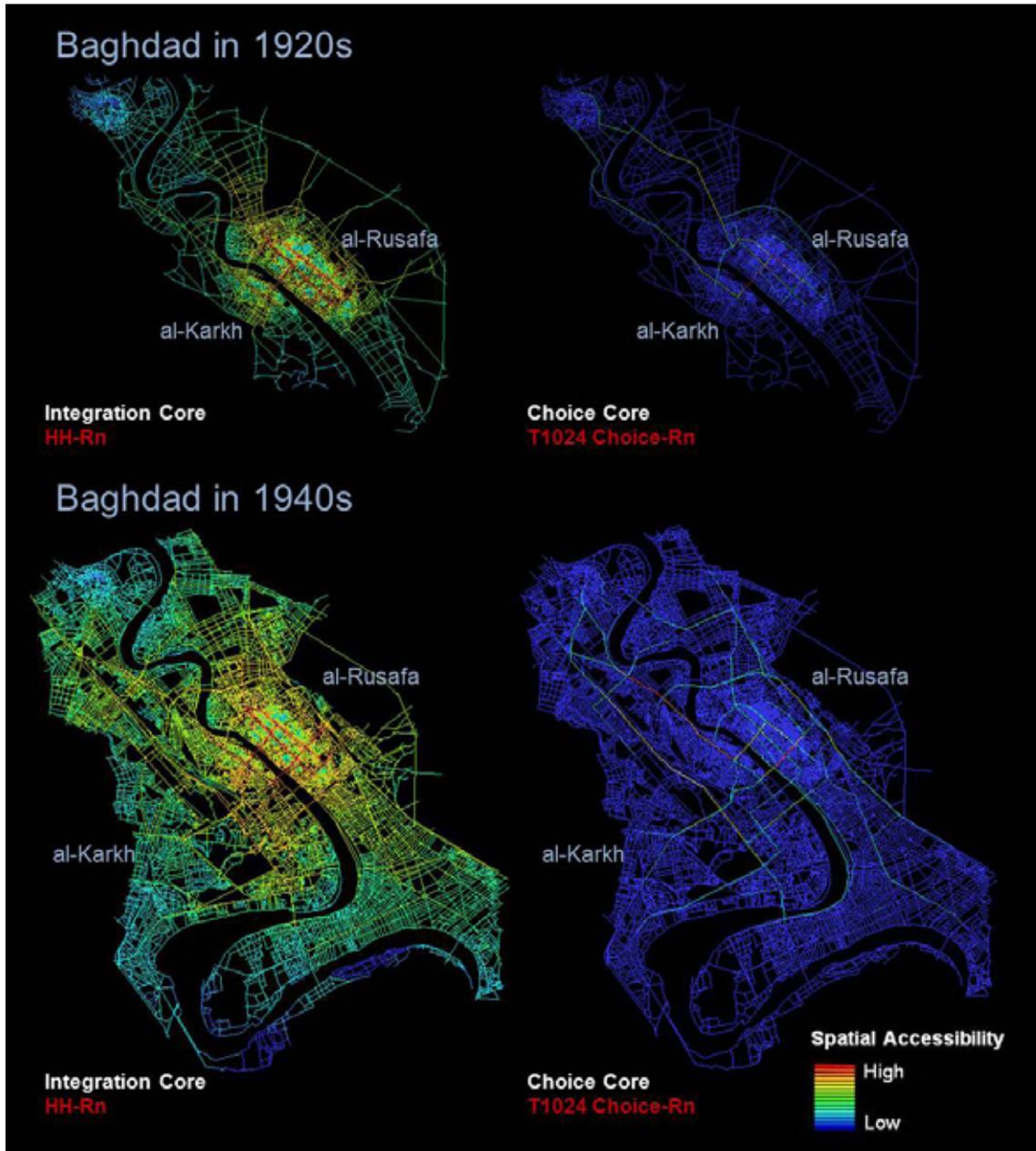


Figure 3 - the maps of Baghdad syntactic urban cores in 1920s and 1940s

- *Choice core:* The segment maps for both phases show that the patterns of choice cores are linear, and are different from each other. In the map of 1920s, the linear pattern was comprised of two main streets with high choice values. The core once again included the old bridge of Baghdad, like the core of the first phase in 1050s. The core also included one of the straightest streets founded by the colonial power in 1920s, currently known as al-Khulafa St. in Baghdad. The street ran parallel to the course of Tigris River. Notice that the core was located within the limits of Old Baghdad in this phase.
- In the map of 1940s, the linear pattern of the core consists of two separate parts: the first part was the Ahrar Bridge, which was founded to connect the al-Rusafa and al-Karkh districts of Old Baghdad. The second part of the core was located outside the limits of Old Baghdad. This part, currently known as Haifa St., was formed in the middle of the al-Karkh and al-Kadhimiya districts to facilitate movement between these districts. (Figure 3)

In summary, the most integrated streets covered the super-blocked grids inside the Old Baghdad, as well as the main bridges that connected the al-Rusafa and al-Karkh districts. In contrast, the streets with the highest choice values were distributed in a linear manner along the main bridges and extended beyond the limits of Old Baghdad, thus facilitating movement by avoiding dense historic organic clusters.

3.3. HYBRID OF SUPERGRID AND FRAGMENTED LINEAR

Hybrid of two different patterns – supergrid and fragmented linear – characterized the integration and choice cores of the fourth phase of Baghdad's maps. The rectangular large blocks with gridded street patterns have significantly affected the density, pattern, and direction of urban growth of the city of Baghdad (Elsheshtawy 2004). For the first time, there was a clear tendency for extending the city outside of the physical boundaries of Old Baghdad. By now, the historic cores (al-Kadhimiya and al-Adhamiyah) had grown in a concentric manner, and had become dense focal points. During the mid-1950s, additional gridded streets were used to connect the historic cores of the city with the larger street system. Although these historic cores were located far from the city centre, their main shopping streets were crowded with pilgrims. These streets were known for their concentration of religious rituals, luxury goods, and antiques throughout Iraq (Al-Ashab 1974, Alobaydi and Rashid 2015). Different in size and shape, many large rectangular blocks included industrial and institutional activities and were laid out based on the master plan of Doxiadis Associates in the late of the 1950s (Elsheshtawy 2004). In addition, four new bridges on the River Tigris were built to connect the two parts of the city - al-Rusafa and al-Karkh.

- *Integration core:* The integration core was formed by two different patterns of streets: supergrid pattern and linear pattern, which were not connected with each other. While the linear pattern was found outside the al-Karkh district and close to the area known as the Green Zone (GZ) nowadays, the supergrid pattern was found in the al-Rusafa and al-Karkh district. The linear street pattern in the map included the longest and straightest road that was built during the urban renewal projects of mid-1960s (Al-Ashab 1974). Within the supergrid pattern, different types of regular and semi-regular rectangular blocks were included along the course of the Tigris River.
- The segregated streets and short lanes were distributed in a scattered manner. The majority of these streets were found at urban edges, in particular in a northeast quarter where warehouses and brick factories with traditional kilns and chimneys were built. In addition, a few of these segregated streets and lanes were found in agricultural areas in the northwest and southeast of the city (Figure 4).
- *Choice core:* The choice core of this phase was different in form and location from the linear patterns in the previous urban choice cores. It consists of two long parts: the first one appeared in al-Rusafa district and continued outside the limits of Old Baghdad along Mohamed al-Qasim Expressway. The second part, similar to the third phase, included parts of Haifa St. between the al-Karkh and al-Kadhimiya districts (Figure 4).

3.4. HYBRID OF LINEAR, SUPERGRID, AND TREE

In the last two phases of Baghdad, the size of the metropolitan city is huge, and the integration and choice cores are more complex than they were in the previous historical phases. They show different hybrid patterns. While the choice core is homogeneously distributed over the whole metropolitan area, the integration core remains concentrated in the al-Rusafa side of the area, particularly around the highway of Channel Army. The River Tigris and the Channel Army now divide the city into three main urbanized areas: 1) Western districts of the Tigris River, 2) Districts located between the Tigris River and the Channel Army, and 3) Eastern districts of the Channel Army (Figure 1), affecting the patterns of the integration and choice cores.

First, with the exception of few remaining organic neighbourhoods in al-Karkh and al-Kadhimiya, most of the western district areas are characterized by widely spaced gridded streets with

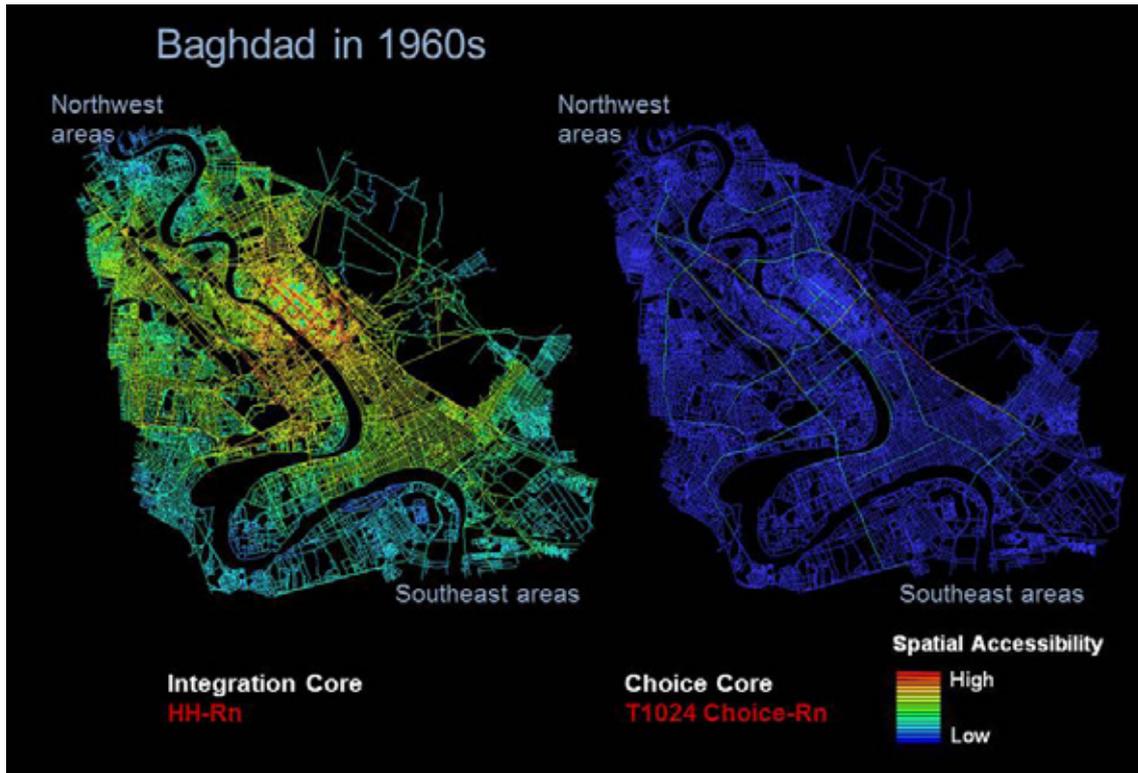


Figure 4 - the maps of Baghdad syntactic urban cores in 1960s

four-way lanes and roundabout intersections, large rectangular blocks, and land parcels often dedicated for residential and institutional activities. Many monumental landmarks, palaces, and memorial parks, reflect a sense of prosperity in these areas as well.

Second, most of historic organic fabrics of al-Rusafa and al-Adhamiyah have been modified by modern planning practices. Many multi-story concrete buildings serving commercial and institutional functions have been inserted in these areas in a scattered manner.

Third, a pattern of rigid rectangular blocks is the main feature of the neighbourhoods and districts on the east of Channel Army. The population of these neighbourhoods and districts often represent middle and lower classes, and are rural migrants who moved from the middle and southern regions of Iraq during the mid-1970s and after (Al-Ashab 1974).

- *Integration core*: A brief look at the axial map of the last two phases of Baghdad reveal an integration core with three different patterns – linear, supergrid, and tree.

The linear pattern is represented by Channel Army (Figure 1), which is the most integrated street in the axial map. Some of the most integrated streets run parallel to Channel Army while others run perpendicular to it.

The supergrid pattern includes streets with high values of integration that partially overlap with the Channel Army. These integrated streets are found around commercial and mixed-use activities in Old Baghdad and its neighbouring regions.

Finally, the tree pattern includes streets with high integration values in the western districts of the Tigris River. This pattern is found close to the GZ and al-Karkh regions, and is connected with Channel Army by a long winding street named 14th July Street along the northwest edges of the city. 14th July Street intersects with other highly integrated streets, such as al-Kadhim Street, 14th Ramadan Street, Rabie Street, Damascus Street, and Yunis Street in a tree-like pattern. In addition, this pattern is connected to the traditional commercial fabrics found in al-Rusafa by the Shuhada and Ahrar bridges. These two bridges facilitate the movement of goods and people between the integrated streets of the tree-like pattern on both sides of the river.

The segregation core with poorly integrated streets includes two separate parts that covered agricultural areas in the southeast of the city. One part, in the southern district of Karb De Gla, includes a set of zigzag streets and small twisted lanes, influenced by topography. The other part, located in a peninsula in Rustamiyah, includes a complex set of small streets and dirt lanes (Figure 5).

- *Choice core*: Similar to the integration core, the choice core of the two phases consists of three main patterns: linear, supergrid, and tree. Most of the streets in the core are represented by highways and main boulevards that often define the boundaries of quarters (also see Rashid and Alobaydi 2015). The streets of the linear pattern include Channel Army and Dora Expressway during 1980s, while the linear pattern includes Channel Army and

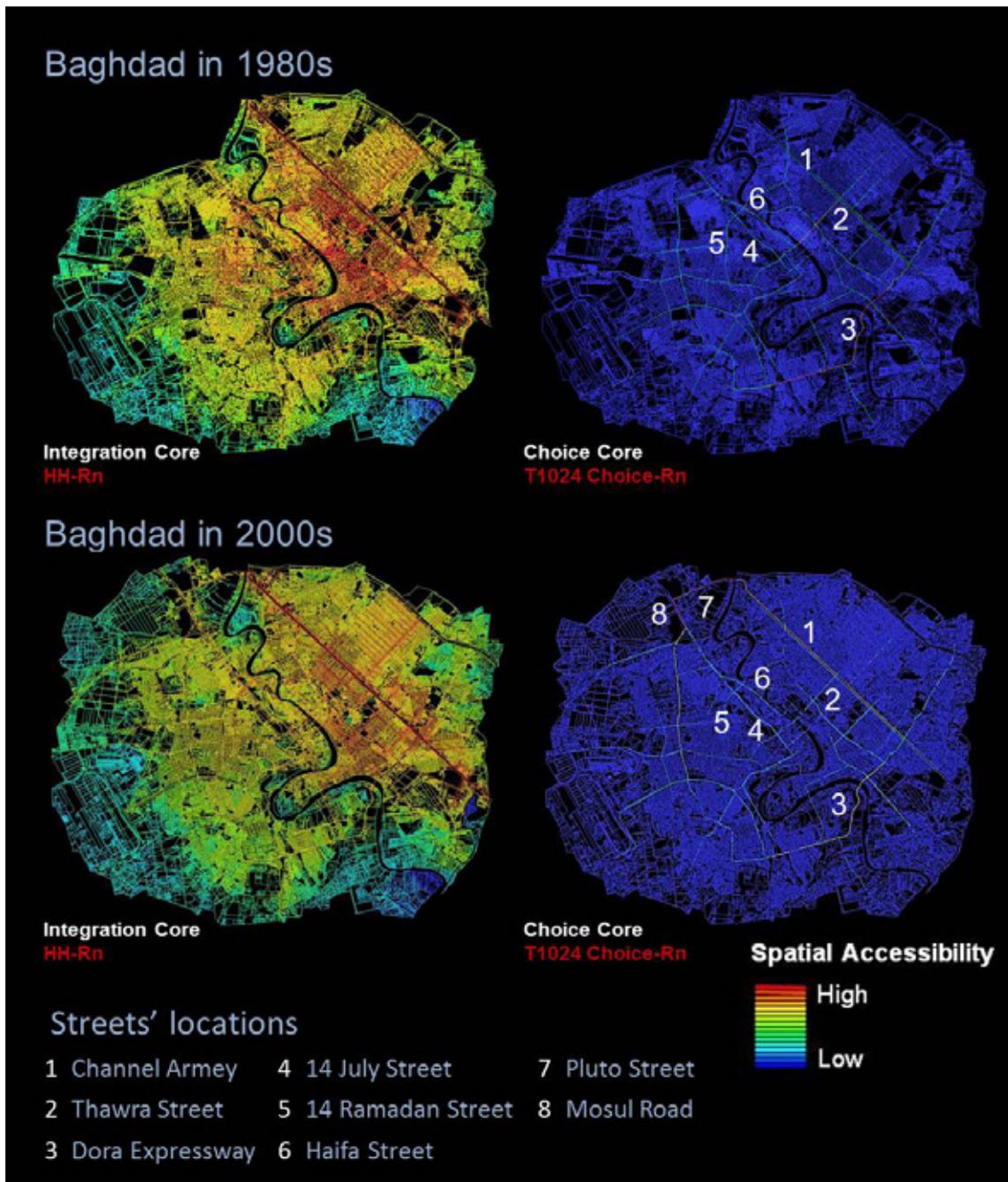


Figure 5 - the maps of Baghdad syntactic urban cores in 1980s and 2000s

Pluto Road located in the northwest during 2000s. The segment maps show that the streets with high integration values in the supergrid and tree patterns are mostly the same streets with high choice values (Figure 5).

4. CONCLUSION

This paper examined the expanding syntactic urban cores of Baghdad, from an organic nucleus to a huge metropolitan city, in relation to land uses and modernization practices. It identified different types of syntactic cores: (1) tree, (2) supergrid, (3) hybrid of supergrid and fragmented linear, (4) hybrid of linear, supergrid, and tree. The paper also described the relationship between these syntactic typologies and different land use activities and/or planning practices in six different phases between the early 19th century and the early 20th century.

Based on the findings, it can be concluded that the urban core of the City of Baghdad has experienced significant morphological changes associated with modern planning practices. These planning practices include, but are not limited to, rigid rectilinear grid systems of roads and highways, superblocks, and land use zoning. It can also be concluded that the city has undergone significant restructuring. As a result, the stable relationships between syntactic cores and commercial and/or mixed-uses that formed in the early periods of the 19th century have changed. More importantly, planning practices and norms used between 1960s and 2000s have influenced the form and location of syntactic cores. It is suggested that different patterns of integration and choice syntactic urban cores have played a significant role in connecting different parts of the large metropolitan region of Baghdad.

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