THE ROLE OF PLANNING URBAN AXES IN THE SUSTAINABILITY OF IRAQI CITIES: MOSUL-CASE STUDY

Nada Abdulmueen Hasan
Lecturer, University of Technology Baghdad, Iraq

Dr. Wada Shuker Al-Hinkawi
Assistant Professor, University of Technology, Iraq

Ahmed Alatta
Researcher, University of Technology, Iraq

ABSTRACT

Urban axes have a prominent role in the sustainability and growth of urban cities. As urban sustainability concepts and their concepts develop, the role of urban planning features in urban cities highlights in promoting the sustainability items completely therefore, the research is based on a basic hypothesis: "the planning and design characteristics of urban axes take part in the indicators of the development and the sustainability of cities." The study aimed to study the concept of the axis in an integrated manner and in several aspects and then review the evolution of the concept historically and studying the most important schemes of urban sustainability. In order to test the hypothesis of the research, the research based on the descriptive-structural approach by adopting the morphological-structural analysis theories in the program (Depth Map 10), and measuring the theoretical framework indicators which are derived from the basic design adopted by the old city of Mosul in Iraq. The research concluded that the design had indicated some items of urban development at the level of urban axes and the need to develop the items multiple linked to the concept of urban axis.

Key words: urban axes planning, urban development, cities sustainability, Mosul city center, Depth Map 10.


1. INTRODUCTION

In the philosophical theses, many of the relationships and concepts that need to be understood and studied are appearing from time to time. Because of the rapid development of concepts of urban design, the sustainability of urban axes has emerged as one of the fundamental affecting trends during the city's growth stages.
This study deals with the sustainability of urban axes through the review of special urban theses at most stages of time, and then the definition of the elements of the comprehensive theoretical framework, thus, the research focused on defining the applied procedures and determining the practical study. The methodology focused on the descriptive-structural approach in two main approaches, the first approach was the morphological analysis in the measurement of a number of the elements of the theoretical framework, the second approach was the conduct of the structural analysis using the program (Depth map 10) for other elements of the theoretical framework, The center of the historical city of Mosul was chosen for the practical study and analysis of the basic adopted design and to identify the most important characteristics of the sustainability of the urban axis and its potential and its role in providing opportunities for the growth of the old city of Mosul and the role of the study and its indicators in achieving of these goals and finally, to review the main conclusions and final recommendations of the research.

2. URBAN AXIS
The theses define the urban axis in different ways according to their intellectual orientations, and the research will provide a comprehensive definition of the urban axis in accordance with the specificity of the research and on several levels to reach the elements of a theoretical framework for research.

2.1. Axis in Linguistic
Within the English language, the Merriam Webster dictionary defines the concept of the axis as "a straight imaginary line that something is going on around it like a globe," and in another definition of the same dictionary "straight line which divides the figure evenly into two parts [1].

As for Arabic language, "Almaany dictionary" refers to it as the axis and the plural axes, axis: An iron, which a reel revolves around it, the axis in geometry is a straight line between the poles of the ball, the axis of the earth: a straight line revolves around it [2]. The definition indicates that the concept of axis in the language is either imaginary or physical line consists of the center of rotation and determine the beginning and end and has a clear direction.

2.2. Axis in Architecture
The line defined in the architecture by connecting two points. The relationship between these two points is determined by the degree of strength of the line which links them. However, the line differs from the point by having a dynamic dimension that determines the direction and nature of the growth, (Ching) states that the line can have the strength of the two-point linkage or the interconnection between shapes at the visual level, at the surface level, it is the relationship of the edge of the surface of its own perimeter. Historically, the concept of the axis has been used to help define the shapes and their proportions. This was obvious in ancient civilizations such as Pharaonic and Greek, which used the concept of mathematical proportions and axes in the design of private temples where these civilizations produced the concepts of the use of the theory of the golden ratio[3]. The definition refers to the strength of the line (axis) which may be due to the strength of points (nodes) which linked them. The theses indicated that the most important characteristics of the axis within the architecture and its engineering characteristics in the orientation and the determination of the edges are its ability to emphasize the significance of the meaning and strength according to the degree of relationship between the beginning and the end and its supporting points, to confirm its The architectural axis can be found in many architectural situations and scenarios. Below are most cases[4]:

http://www.iaeme.com/IJA/index.asp 19  editor@iaeme.com
The axes indicate the characteristic of movement and visual perception along the path.

- Linkage between two points often represents the beginning and the end of the shape.
- The axis can carry a range of meanings and messages from the beginning to the end of the axis.
- Arranging shapes symmetrically in a specific geometric approach, giving a dynamic shape, emphasizing horizontal and vertical shapes, isolating shapes or diagrams into multiple circles.

The above theories indicate that the physical function of axis is to be either an orientation or an (edge determination), and the most important characteristics which the axes have are the Symbolic, Connectivity, Symmetry, and Direction.

2.3. Axis in Urban Design

The urban history has many urban axes and in many forms. Each axis reflects the characteristics of that civilization, the cultural characteristics or the spatial elements that characterized it at that time[5]. The ideas indicated that the urban axes are the comprehensive spatial structure located in cities all over the world, the difference lies in the urban context within the mechanisms of planning and design of this axis and the role it plays in the context and the urban fabric of that city. Most of the organic cities that have grown in the ages have been exposed to the addition of new axes within their urban fabric, either to urban development or to the development of an existing urban axis.

The urban axis can be defined as "urban space that carries a certain direction within the context of the urban city, and includes a set of spatial elements to determine its own identity".

Two main types of urban axes can be categorized in terms of directivity, they are as follows:

**Central Axis:** The central urban axis refer to the linear spatial component that dominates the entire urban environment. within a specific urban fabric or context, which plays the largest role in the organization and control and it is considered as the backbone of the urban space as it has the ability to control the main urban functions supporting the spatial structure of the city, the central axis play a dominant role in the form of the city, and the main direction of its development, because of the great role it plays in the urban growth of the city, the most important axis are the Champs-Elysées axis in Paris[6].

**The multi-directional urban axis (Broken Axis):** The multi-directional urban axes defined as the axes that are not in a one straightness within their urban fabric due to the presence of distinct urban elements that influenced the generation or the growth of the axis. The word "Broken Axis" may indicate in terms of language that the axis has negative characteristics, but it does not, as illustrated by the urban characteristics it possesses in promoting the urban fabric within the city. The most important of these characteristics are the generation of spatial diversity, emphasizing its importance, unifying the direction[7].

The above suggestions are indicated, that the most important urban elements identified by the research, is (Symbolic), which issued to confirm a particular date, to express thought, or carries messages and specific meanings, the linear elements of the axis, which referred to two basic types, (A central urban axis in one direction, multidirectional). Directivity and the element defined three sub-elements and they are (a sign of the symbol, emphasis on the importance, unifying the direction).
3. URBAN AXIS IN HISTORY

The urban theories indicated to the importance of the axis in the formation of cities and across the ages for a number of reasons and to identify the most important elements of urban axes through history and the affecting dimensions of their development, the research tend to study the characteristics of the axis through the ages and distinctive civilizations as follows:

3.1. Axis within the Roman Era

The urban axis in the Roman cities were clearly defined by the orthogonal urban structure in the planning of the Roman cities by two main north-south roads (CARDO MAXIMUS) and East-West (DOCUMANUS MAXIMUS), which indicated four main characteristics of urban design: Location, urban area, directional streets, emphasis on techniques. (Luis Munford) points out that the Romans learned from the ancient Greeks and then formed their own concept and elements of the urban axis through urban squares that are consistent with the continuous urban axes with urban buildings on either side[8]. The main streets marked the large harmonious building blocks on both sides of the street which reflects the strong power and its high influence on the urban fabric of the city, the connection of the urban axis to the main areas, and the role of the urban blocks which are surrounding the axis in providing functional and aesthetic power[9].

3.2. The urban axis within the Medieval, the Braque, and the Renaissance

**Medieval**: the changing of the urban structure of the city and population growth clearly affected the structure of the streets within them, and the cities were greatly affected by the influence of its unplanned and rapid growth at that time, which led to the emergence of organic style, and the concept of axis did not have a great role in emphasizing the buildings through it, and the cities in that period didn’t witness any differentiation between the types of streets, but it included urban axes to link the city gates or central squares[10].

**Renaissance**: this period was characterize by a growing emphasis on the aesthetic proportions of the human, the symmetry and balance that significantly restored Platonic models and led to the reduction of the organic model that prevailed in the Baroque era, which is the main difference between the two periods, and the new urban axes within the fabric directly referred to the principle of urban communication between society and the achievement of cultural and civilizational growth at that time, and indirectly led to the confirmation of the idea of urban integration between the fabric[11].

**The period of the Baroque era**: this era marked by a distinct difference from the previous period in terms of the concepts of urban design, as the idea of urban axes between the fabrics indicated the principle of linearity and represented the privileged part of the city's urban structure. Bacon pointed out that the main purpose of constructing the axis was not to achieve social communication, but to focus on the absolute religious authority of Christianity at that time, and the axis achieved the attraction between the elements of (Monumental) of high impact to provide a continuous movement between them. this idea was clear even in the works of Michelangelo in his famous painting (The Hands of Adam and God painting) which is a clear example to emphasize the idea of attraction between the two dominant elements[12].

The concept of "central axis" in the city can be considered as the main element in the design of the Baroque cities as described by the urban researcher (Spiro Kostof) in the concept of the (Grand Manner), where the urban axes represented a new concept of the relationship between the big streets and buildings as the streets are no longer used for just a transport function, but rather represent an independent and integrated entity that reflects a
particular thought or principle of communication with the urban centers of great importance[13].

The analysis of the axis in the Renaissance and Baroque shows the use of urban axes as elements of the linkage between two urban attraction points and the affirmation of the aesthetic proportions, both on the level of symmetry or balance on both sides of the axis and the function of the axes are not only for transport but also as an important urban activity within the fabric of any city center.

4. URBAN AXIS IN THEORIES OF MODERNITY

Many of the theorists identified the idea of adding urban axes within the fabric and the generating of an urban component that grows on its basis the rest of the city, in contrary to the idea of the overall design of the city. Many of the theorists have adopted this idea and the most important of these suggestions or theses are:

4.1. City Beautiful Movement

The roots of this movement date back to the nineteenth century and the emergence of urban axes in European cities such as Paris and Vienna. This movement has spread in America, mainly in most major commercial cities in the 20th century as the leaders of the European cities tended to leave the idea of the urban bourgeoisie and strengthening urban trade relations and interaction with the city, the movement reached its peak in (1930) to confirm the idea of the importance of capitals and praise. the principles of the city beautiful movement, whether used during the design of a new city or during the process of urban development of existing city, it depends on the function of the urban (axis) for its functional and aesthetic aspects[14]. One of the most important urban axes that was created on the idea of the city beautiful movement is the added urban axis for the city of Washington during the process of urban development in 1901.

4.2. Edmund Bacon: Organizing the Urban Main Structure

Bacon suggests that any project for any part of the city must be consistent with its urban structure and that it must be flexible enough to provide its own urban growth opportunities therefore, the urban axis must be consistent and includes most of the important buildings, (Bacon) summarize his theory in the idea of "Although the leaves go and come every fall and spring, but the trunk and branches of the tree remain and they are the shape of that tree”[15], and to identify the most important theoretical elements associated with the concept of urban axis, the study examines a number of urban theories:

4.3. Jane Jacobs Suggestions or theses

(Jacobs) emphasized in her suggestions that the most important requirements of urban axes are the high intensity to generate urban activities on an ongoing basis because they play an important role in generating high spatial diversity within the urban fabric surrounding the axis. She pointed out that emphasizing the historical and spatial aspects of the axes plays an important role in its specificities within cities and on the identity of the urban fabric in particular, and one of the most important factors leading to the weakness of the urban axis and then to the disintegration of the fabric is the policies of functional zoning and as a reaction to these policies she pointed out to the need to move towards mixed use, and the overlap of urban activities, as a basis for generating developed urban axes[16].

The high-density policy within urban axes is of high importance, as (Llewelyn-Davies) emphasizes, where the most important effects are summarized as follows:
5. THE THEORIES OF CONTEMPORARY URBAN AXES PLANNING

The contemporary suggestions of the sustainability, which focuses on urban streets or axes, refer to the highly activation of the social role and the requirements of pedestrians within the street, with the rehabilitation of urban areas that are of great importance in the design or urban development of the urban axis, the research aims to review a number of suggestions or theses for the sustainability of urban streets in order to identify the most important elements of the theoretical framework related to sustainability of urban axes as follows:

5.1. (Allan Jacobs and Donald Appleyard) theses or suggestions

In the mid-1980s, (Jacobs & Appleyard) published theses, the main object of which was to oppose the ideas of modernity in the city as embodied in the charter or constitution of (CIAM) in Athens because of its emphasis or focusing on the buildings and its internal functions rather than on urban space and its role in the development of the city, in addition, they noted the decline of urban development in postmodernism inside or within the design professions, including the withdrawal from social participation to formalism, where architecture finds its final theses or suggestions in the art exhibitions, while the city planning immersed, on the other hand, in Urban management instead of being a tool for highlighting a clear feeling of the direction or trend regarding the urban design[17]. (Jacobs & Appleyard) pointed out to some major problems in their criticism of contemporary urban design, to some big problems and the most important issues are the neglecting the human scale, the tendency towards a sense of loss of control, the emergence of consumerism and its focus on the individual, as well as the spread of cars that led to Privatization, and the separation in urban space, while public space - especially in American cities - has become fragmented and desert, resulting in the loss of public life leaving little room for various social groups to meet, resulting in the division of the city into Provinces or homogeneous blocks of housing, the remaining of historic urban environments has been destroyed by tourism and economic exploitation, while the remaining places of the urban environment (which lack the sense of place) are isolated and incapable of making any sense to us[18]. (Jacobs & Appleyard identified) set or specified five "characteristics" or means that are essential for achieving sustainability of cities. These natural characteristics can be summarized as follows: streets and livable neighborhoods, minimum density or minimum density, functional integration and proximity, positive urban space, human scale and diversity or variety. Jacobs & Appleyard[19], emphasized that urban axes are not just a transitional area, but also a framework for "human exchange, public life and diversity within society", and there must be a certain density of people. For this reason and in order to increase the mass transportation, they suggested the minimum density in most parts of the city, and urban areas must be a particular mix of uses for life generation. The high integration of housing, workplaces, shopping and entertainment - if not always within the same area – should at least be located within walking distance[20]. Jacobs & Appleyard emphasized the concept of versatility and diversity within a single context, but they did not address the relationship between the city’s parts between and its different contexts. Thus, the theory presented solutions at the level of the part rather than the whole and therefore did not emphasize the concept of urban integration of cities with green areas, but emphasized or confirmed the role of the urban axis as an important channel of social communication in the
community and the need to reduce the movement of cars to increase social interaction within its components.

5.2. (Carlson & Kanninen) Study entitled ("Street Design: Sustainable Street")

The study pointed out to the promotion of urban sustainability objectives through many of its elements which should be available in the urban streets. The most important of these elements are the protection of public places, the provision of transport alternatives, commitment to the goals and regulations of climate change, landscape protection, use of natural resources efficiently and responsibly, in general, the study defined sustainable streets as "the provision of multiple rights within the urban environment", most of which are related to three basic requirements: movement, society and the environment. It can be said that the successful sustainable development projects for urban streets often need to make fundamental changes: pedestrian, environmental and economic[21]. The study classified the sustainability dimensions of the streets into three main dimensions, first, the urban environment dimension (pedestrian movement and ecological objectives) second, the social dimension (community and pedestrian movement); thirdly, the economic dimension (society, ecological goals and pedestrian movement), and identified the most important benefits of urban sustainability dimensions of urban streets of the three dimensions as follows[22]:

At the level of movement: the provision of less polluting streets while limiting the use of the car within the street, and to ensure the provision of transportation methods compatible with each community according to its specificity.

At the community level: the streets should reflect societal values in terms of cultural, economic and social needs, with the supporting of the objectives of urban composition that emphasis mobility objectives

At the level of the environment: protect the natural materials of the street if any, with the provision of environmentally friendly design strategies both in terms of materials or methods of implementation.

5.3. New Urbanism

The concept refers to linking of the natural environment with the urban environment of the city as it provides a set of principles for planning and urban design that has the ability to generate an urban community environment for pedestrians in the important urban nodes of the city and to reduce the number of vehicles within traffic routes to make the urban environment safer and more comfortable. The new urbanism concept with significant importance to generate high interactions among people in general within the city, and linking urban units adjacent to each other to strengthen centers and urban nodes and the organization identified the most important principles of the new urbanization as follows[23]:

(Walk Ability): It indicates that the design of the streets should be commensurate with the movement of pedestrians (buildings include within the sidewalks a green belt around them and reduce the paths of traffic within the street)

(Connectivity): emphasizes the need to link the movement of the streets with each other and make pedestrian movement easier, and provide a balanced hierarchy.

(Mixed Use Diversity): Mixed diversity of shops, offices and apartments within design and mix use to generate the diversity from different ages, classes, cultures and races.

(Mixed Housing): Provide different models of housing and keep them close together.

(Quality Architecture & Urban Design): Focus on the values of beauty and well-being with the adoption of the human scale as a means to develop the urban environment, including urban squares.
(Traditional Neighborhood Structure): Emphasis on the distinctive boundaries (edges) of the traditional city, the provision of central urban spaces, the provision of a distinct urban environment, and the generation of a distinct range of urban options within the traffic (movement) routes.

(Smart Transportation): Providing a high quality of transport networks linking cities and neighborhoods, encouraging the use of bicycles and focusing on the corridors that supporting pedestrians as a means of daily use.

1. United Nations suggestions or offers (UN Habitat): In 2014, (Habitat) suggestions or offers indicated to the strategies for the development of a sustainable environment in urban planning, and identified them by five key elements[24]:

Provide highly efficient streets: aim to try to make the streets sustainable through space and effectiveness, and emphasizes the need to encourage the movement of pedestrians and bicycles along with public transport.

High densities: The report emphasized the problem of rapid growth and put forward a mechanism to reduce Urban sprawl and promote the concepts of sustainable urban growth through the mechanism of high densities, which are trying to concentrate urban activities of the city within the least urban area possible.

Mixed uses: refers to the development of a range of compatible activities and uses of land adjacent to each other within the urban fabric in a flexible way to try to adapt with the passage of time with the requirements of the community, and the purpose of adopting the principle of mixed land usage is to create local employment opportunities, strengthening the local economy and reducing dependence on cars to encourage pedestrian traffic or movement, reduce fragmentation of the landscape and minimize the principle of land use within a single function.

Social interaction: Aims to enhance the interaction between different social classes in society itself, and to ensure access to fair urban opportunities by providing different types of urban activities.

Specific uses: Aims to modify or limit the use of functional division to implement different policies and thus generates a neighborhood (district) of one function which is one of the most important contemporary urban challenges including city congestion, insulation, and dependence on cars.

5.4. (Peter Caltorep) suggestions or theses
Caltorep re-categorized the urban growth patterns of the city and the urban suburbs based on (diversity, passers-by (pedestrians) movement, public space, the boundaries of urban districts (neighborhoods) structures) and pointed out that these principles should be used in all urban areas and urban growth policies of the suburbs, the urban nodes must be considered as important urban centers for development policies, with the identification of urban boundaries (edges) with characteristics within cities, including the most important criteria of development are the human scale, attention of pedestrian movement, diversity in urban economic, residential activities and other events, and the urban spaces must be hierarchically linked within an urban axes that fulfills these qualities [25]

5.5. New Urban Conference (CNU) for the year 2012
The conference identified a number of sustainable street principles related to the three goals, which were identified in the previous study. The research reviews the principles related to the streets as follows[26]:
The establishment of a network of streets which are compatible with the local community, which has the ability to connect the pedestrian with others and provide meeting opportunities, and also has the ability to promote the sites of recreational activities and public events to build an effective society.

**Establishing a network of streets that attract economic activities** and provide a diverse mix of cultural, commercial and residential activities, thus achieving optimal use of the land.

**Provide multiple transportation options**, transport networks for a public transport group that allows all groups of society to move or travel easily and provide pedestrian walkways, the possibility of crossing, and use bicycles to their destinations easily.

**Integrating the streets with characteristics and natural elements**, integration with the natural ecosystem at the level of part or all.

**Respect for the local urban environment**, respect for the unique local and historical peculiarity or the characteristic of the urban and natural environment, which include architectural characteristics, urban, history in an integrated design style.

**Adopting the pedestrian movement**, the network of sustainable streets should be design to provide the visual and mobility pleasure for pedestrians.

Sustainability suggestions referred to a number of key words of the urban axis that can be summarized in Table 1, and their adoption of planning and design characteristics of the urban axis, which achieve sustainability and Urban Development in the cities.

### 6. PRACTICAL STUDY

The scientific study aims to test the theoretical framework; the study adopted the basic design study of historical city center of Mosul (Urban Renewal Project for the Old City of Mosul) which was present by the consultants (Dar Al Amara, SGI & Hana) to the Municipality and Public Works Directorate General of Urban Planning-Iraq 2008. as the city will witness a comprehensive architectural movement after liberation, which requires the evaluation of approved design indicators and identify the items that need to be added before starting the reconstruction process to achieve the best planning and design characteristics of the urban axis in the city, and enhancing opportunities for urban development.

#### 6.1. Reasons for Selecting the Study Area

The city of Mosul has been elected because it represents a large part of the historical and cultural history of the Silk Road historically and the present Nineveh province, It includes a wide range of urban systems that must be analyzed as having characteristics in urban development. The group of morphological element in the traditional city with other urban elements representing morphology Modern city due to the different elements influencing urban development over time, as well as the guarantee of urban morphological documentation over time and its retention of too many characteristics during its development process.

#### 6.2. Boundary of the Study Area

The spatial boundaries of the study area were elects from the old city of Mosul and parts of the modern neighborhoods towards the city of Kirkuk governorate. the study area extends from "Abi Tammam bridge" (north) to the fourth bridge (south) and from the train station which is located in Ibn al-Thaer Street (east) to the Tigris River (west), the study also contains (the old city, the train station, Alrafidain district etc.). In terms of urban axes, it is one of the most important objects within the study area, and for the reasons to choose this particular part of the study area are:
The city of Mosul represents a historical, civilization and urban identity important for the province of Nineveh, especially Iraq in general. The region includes many important urban and architectural features, which have been established important development dimensions for the city history. The region contains many diverse urban activities that could be the cause of its development if invested correctly.

6.3. Type of Measurement Selected
Due to the multiple dimensions of development, two methods of measurement will be adopted which are:

- **Descriptive-Morphological Analysis**: which aims to collect, classify and analyze facts and data while attempting to interpret these facts sufficiently to reach generalizations on the subject of the study.
- **Configurational Analysis**: using Depth map program, which includes each of the following metrics (for Global Properties)[27]:
  - **Integration value**: the degree of integration refers to the interconnectedness or isolation of space relative to outer space (Carrier). Integration relationships include the concept of relative symmetry scale is generalized by comparing the depth of the system from a given point with its theoretical depth. The lowest depth is calculated when all spaces are connected to the original space. The deepest degree will calculated when all the spaces are arranged in linear succession away from the original point.
  - **The Choice Value**: The degree of choice is an indication of the degree of control achieved by space over the permeability of adjacent spaces. It is the most likely space and the shortest way to connect the parts of the system to each other or to the outer perimeter, regardless of the number of changes in direction and number of axial steps. And thus the degree of choice is an indicator of the distribution of the total movement of the pedestrian in the system, which take the shortest route in the transition between the parts of the city based on the experience gained as a result of continuous use and mental schemes of their own.

6.4. Description of the Study Area
The ancient city of Mosul, the center of Nineveh province, has two main axes in its formation, which are:

**A-Ninveh Street Axis**: the street runs through the old city from east to west, extending from the iron bridge to the head of (AlJada'a District) the length of the street is about 2 km; also, it considered one of the wider and straight streets that runs through the heart of the old city. The opening of Ninewa Street in the old time and particularly in this place is a new development that the city has not experienced throughout its history. It has changed the old city's narrow roads, in terms of its long-standing integrity in the old city, in the installation of eight residential districts. The most important is the concentration of commercial buildings which contain Multi floors and modern architectural style.

**Al-Farouq Street Axis**: the street penetrates the old city from its south to its north. It started in the mid-1930s and ended in the early 1950s. the impact of this street was on the internal structure of the old site clear, when nine residential neighborhoods were breach. In addition, it is one of the specialized streets not only in the disposal of goods and goods, as is the case in Nineveh Street, but also the shops of plumbing and trade.

The adopted design suggested the development of the two main axes in the city Figure (1), the objectives of the urban renewal of the city axis are not only to restore their structure, splendor
and magnificence as an economic center, but also to preserve the spirit of the city and to combine traditional and technical items through:

- Respecting and preserving the natural, cultural and traditional heritage of the Old City.
- Combine between modern and technical developments with major service systems and old buildings to reach a convenient and easy city to live.
- Adopting the principle of sustainable development in urban axes not only the level of form but also a mechanism for sustainable economic development.
- The study showed the interest for main axes based on the distribution and expansion of the characteristics of the axes, although they are historically important, but the study has employed them more to be the most permeable and easy to use methods within the city by generating the high spatial diversity of the events and incorporating most urban development processes.

7. ANALYSIS RESULT

First: Urban-morphological analysis, the results of the morphological analysis showed as follows:

- The importance of the urban axes in the city of Mosul is the interconnectedness of the urban fabric of the old city and the absence of a clear directional movement in secondary axes at the micro level. the overall level, shows the direction of the traffic axes clearly at the intersection between the two axes at the clock district, especially the two main axes that penetrate the old area (horizontal,& perpendicular axis), the Nineveh Street axis, which is a one-way axis, not visually-linked with an urban node with an unclear, represents the dominance of both (political and social) level, because it represents the beginning of its establishment, also it is difficult to define a clear structure of the axis or a clear hierarchy, we can say that the axis has become an integral part of the surrounding urban fabric at this stage, also it is linked to quite a number of main streets linking the axes. The street network shows the organic system and the compatibility between the forms of the fabric and its function. Therefore, the functional continuity of the fabric can be consider as an indicator of its vitality and emphasizes the history of the old city, as in figure (1).
- The urban axes contain a number of urban features, one of main axis objective was to connect and facilitate the connection between the city's historical monuments and its important urban areas, which were the main reason for the formation of the street and its current extension, but it did not represent a clear urban node within its urban fabric. It is the intersection of the two axes and one of the most important urban nodes, as in figure (1).
- The study showed a list of heritage buildings, which can be considered an important; source for the urban development to the city of Mosul and to strength the dimensions of sustainability. In addition, the preservation of building heritage in terms both maintenance and restoration, the importance of it is location within the old urban axis of the city and its role from the point of view of economic activities as well as its strategic location, Which makes it versatile throughout the day, figure (2)
- The study provided a number of pedestrian routes that fit the trends of urban sustainability; the study divided the roads into a walkway (RF), cross roads (RF). It also emphasized the preservation of traditional and spatial diversity within old
markets and taking into consideration the future expansion to meet the increasing demand due to Population numbers this, as indicated by the study to reduce the movement of vehicles and traffic jams, as shown in Figure (3)

**Figure 1** Urban Development Study of Mosul City / Source (Urban Renewal Project for the Old City of Mosul) submitted by the Consultants (Dar Al Amara, SGI, & Hana)

**Figure 2** Urban heritage sites / source (Urban renewal project for the old city of Mosul) submitted by consultants (Dar Al Amara, SGI, & Hana)

**Figure 3** Sustainability trends within the pedestrian / source sections (Urban Renewal Project for the Old City of Mosul) submitted by the Consultants (Dar Al Amara, SGI, & Hana)
Second: Configurational Analysis: The results of Configurational Analysis showed the following:

Integration: The integration core showed an average value of (1.3). The integration core shows also clear importance for the axis of the old city of Mosul, which has the highest values of integration in the clock intersection area (the intersection of the two ancient axes). The value of integration core decreases as we move away from the old city axis towards the river or the western side of the city, but it is still relatively high, while the lowest nucleus of integration was formed in the far areas towards the river, worth (0.76), Figure 4.

Choice: The scale indicated that the average value of the scale was (0.0078) and the highest value was (1.22) at the beginning of the urban axis of the old city and gradually reduced as the axis moved towards the river. The lowest values of the choice core were in the areas far from the axis towards the river and amounted to (0.001), Figure (5).
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8. CONCLUSIONS

- The urban axes are important elements in the structuring and shaping of cities across the different stages of time. The importance of the urban axis and its role in the sustainable development of cities and changing their role and characteristics have increased from streets to traffic to economic, social and environmental development spaces. In addition, with rehabilitation of urban areas and monuments which have a high importance in urban development of the city, as any development of one component is not sufficient to achieve a sustainable urban fabric unless it is a component Axis and its core components are compatible with sustainability processes.

- The analysis of the proposed design for the development of the old city center of Mosul revealed the development of social indicators and urban sustainability within the urban axis of the old city, with the need to strengthen indicators of urban sustainability on all components of the urban axis, especially Nineveh and Farouq streets and at the level of all rather than part and on a long-term basis.

- Sustainability Theories referred to a number of key terms of the urban axis that can be summarized in Table 1, and their adoption of planning and design characteristics of the urban axis. Sustainability and Urban Development

<table>
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<th>Nature of the Relationship Check</th>
<th>Possible Values</th>
<th>Key Items</th>
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<tbody>
<tr>
<td>✓ Central Urban Axis in One Direction</td>
<td>Linear Elements</td>
<td>Formaion of The Blocks</td>
</tr>
<tr>
<td>✓ Confirma Specific Date</td>
<td>Symbolic</td>
<td>Urban Axis</td>
</tr>
<tr>
<td>✓ Contains Specific Meanings and Messages</td>
<td>(Direction)</td>
<td></td>
</tr>
<tr>
<td>✓ Indication of The Symbol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Emphasis on Importance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Unite Trend (Direction)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Expression of Thought</td>
<td>Formation of surrounding blocks</td>
<td></td>
</tr>
<tr>
<td>✓ Integration with The Surrounding Fabric</td>
<td>Relationship with Context</td>
<td></td>
</tr>
<tr>
<td>✓ High Density</td>
<td>Implication</td>
<td></td>
</tr>
<tr>
<td>✓ Optimal Land Exploitation</td>
<td></td>
<td></td>
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<tr>
<td>✓ General Transportation Adoption</td>
<td>Movement System</td>
<td></td>
</tr>
<tr>
<td>✓ Reduce Traffic (Movement of the Cars)</td>
<td></td>
<td></td>
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<tr>
<td>✓ Adopt Pedestrian Traffic</td>
<td></td>
<td></td>
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<tr>
<td>✓ Generating Spatial Diversity</td>
<td></td>
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<tr>
<td>✓ An Extension of a Particular Date</td>
<td>Usage</td>
<td>Urban Space</td>
</tr>
<tr>
<td>✓ Integration with Requirements</td>
<td></td>
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<tr>
<td>✓ Emphasize The Use of Public Activities</td>
<td></td>
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</tr>
<tr>
<td>✓ Provide Green Spaces</td>
<td></td>
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<tr>
<td>✓ Between The Nodes</td>
<td>Linkage</td>
<td>Extension</td>
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<td>✓ Between Sectors</td>
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<td>✓ Space Integration</td>
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<td>✓ The Scene</td>
<td>Symmetry</td>
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<tr>
<td>✓ Fabric</td>
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<td>✓ Functional Balance</td>
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<tr>
<td>✓ Increase in Density</td>
<td>Growth Index</td>
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</tr>
<tr>
<td>✓ Continuity with Axis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Inter-Sectoral Connection</td>
<td></td>
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</tr>
<tr>
<td>✓ Optical Axis / Aesthetic Function</td>
<td>Axis Type</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Indicators of Theoretical Framework Measurement (Urban Axis) - Source (Researchers)
REFERENCES

[5] Ibid,P17
[18] Ibid,P117
[20] Ibid,P170

| ✓ | Functional Axis / Total Functional Coherence |  |
| - | Environmental / Optical Axis, Aesthetic, Green |  |
| - | Symbolic Axis |  |
| - | Default Axis |  |
| - | Closed Axis | The Nature of The Axis Relative to The Context |
| ✓ | Open Axis | Identity |
| ✓ | Achieving Belonging to The Place |  |
The Role of Planning Urban Axes in the Sustainability of Iraqi Cities Mosul - Case Study


[22] ibid

[23] [http://www.newurbanism.org/]


[27] Ibid, P117

