# The impact of the morphological dimension of digital architecture on the strategic value of the urban fabric.

## Central Bank of Iraq (CBI) in Al- Jadriyha— a case study

Shahad Abdulabbass Hammoodi [a] (Ph.D.)
Wahda Shuker Mahmoud [b]
* *a Department of Architectural Engineering, University of Technology, Baghdad, Iraq*

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## ABSTRACT

Various models of digital architecture have appeared globally, affecting its context in different formats and dimensions. With its free forms and complex topology, digital architecture creates new formation of cities and affects their visual, material, and morphological features in terms of re-reading and defining their spaces, urban landscape, and even their functions this creates a space for continuous dialogue that encourages social interaction and contributes to creating economic attraction points that positively affects the spatial and strategic value of the urban fabric thereby transforming into an opportunity for its redevelopment and the rehabilitation of some isolated areas within, in addition to emphasizing the environmental aspect Via the creation of environmentally friendly buildings. The impact of the morphological dimension of digital architecture on the urban fabric of the city is not clear in previous studies. The aim of this research to clarify the impact of the morphological dimension of digital architecture on the strategic value of the urban fabric, it is assumed that adding digital buildings to the fabric raises their strategic value through the impact of their dimensions in the surrounding context. Additional aims are to measure the strategic value of the site and clarify the importance of selecting the sites of digital architecture in reviving parts of the urban fabric to achieve economic, social, and environmental development. The space syntax method of structural analysis is adopted with analysis conducted by adopting the extension of the Axwomen program within the GIS program to measure indicators of the strategic value of the Central Bank project in Baghdad as it is a product of digital architecture. The strategic value of the newly built Central Bank site was determined as (5.2), i.e. for its location within the nucleus of integration, as it is directly linked to the axes of the main streets and directly connected to the Jadriyha node, which has the highest strategic value of (9.34) there for the results of the study confirm the need to determine the sites for adding digital buildings within urban development processes to reactivate weak areas in a way that enhances spatial connectivity and enhances social and economic communication.

## KEYWORDS

digital architecture, strategic value, morphological dimension, Central Bank of Iraq, Space Syntax, Axwomen, GIS.

# 1 INTRODUCTION

Cities witnessed many changes at the urban level as a result of technological empowerment in architectural production. There is a spread of digital buildings and structures characterized by their parametric design, morphological patterns, and manufacturing systems. This new architectural language has brought about fundamental revolutions in the city environment due to its dynamic line curve. Digital architectures do not only represent "intellectual space." instead, they are also non-traditional places of social interaction because of the new types of events and functions they bring [1]. With the increasing development of digital technology and information networks in the twenty-first century, a radical change has appeared in the style of buildings of all kinds, functions, and the way they perform these functions. This has also greatly affected the formation of cities as a result of urban and spatial changes and the significant change in the concept of time and space [2]. Digital technology has helped to develop the performance of architecture through data-based research, modelling and simulation, computer programming, multimedia presentation, knowledge, and information. The use of digital technology is not limited to only the design and planning stages, but extends to the implementation, product manufacturing, and building construction stages [3]. Cities with traditional centres can be revived through digital buildings, as digitally designed urban spaces and forms affect the city and its urban spaces and create a distinctive space organization, which contributes to converting cities into museums of avant-garde architectural elements, attractions for capital and tourism in the world and places for social interaction [4], in addition to the formation of a new space structure whose names have been multiplied by those concerned with future architecture, so Graham & Marvin called it (electronic space), and Michael Batty called it (cyber space), as for Manual Castle, he called it (the space of flows), which is the most comprehensive expression for those concerned, as the space of flows is defined as "the new spatial form of the information age", where spaces flow within the infrastructure of information systems to lead to synchronization between social and administrative relations and other various life activities without the need for spatial transgression by changing the spatial dimension and spatial conditions to perform some functions [5]. William J. Mitchell and Nicholas Negroponte emphasized the increasing importance of urban centres due to the modern buildings added to them, which achieve remarkable changes in their fabric. The various dimensions of digital architecture influence major cities, turning them into main points in serving them, organizing their relationships, and form connecting nodes to strengthen the fabric network. These nodes increase the strength and complexity of the networks, which increases the strength of their influence and the scope of their services [4][6]. The creation of a common relationship between urban spaces and digital buildings is either complementary or substitutional, that is, adding them to spaces to re-integrate the fabric of the city, or support major urban centres, or to relieve the pressure on service centres, [7]. This research deals with the problem of the lack of clarity over the impact that the dimensions of digital architecture have on the spatial value of the urban fabric, as indicating the impact of its dimensions is necessary to determine the locations of its sites within the fabric in urban development processes by activating isolated areas and restoring their cohesion with the fabric, It is the research assumed that adding digital buildings to certain sites of the fabric is raises the spatial value through their different dimensions in the surrounding context. Another aim is to extract indicators of their dimensions that help in reviving isolated parts of the urban fabric to achieve economic and social development. To full fill the aims of the research, the following steps were taken:

- Defining digital architecture and its most important characteristics that affect the spatial value of the urban fabric and defining the strategic value.

- Determining the effect of the morphological dimension of digital architecture on the spatial value of the urban fabric, and measuring its strategic value indicator.

- Test measuring the strategic value index of the digital architecture site in the Axwomen program within the GIS program, as part of the Central Bank of Baghdad project for the late architect Zaha Hadid, both before and after adding the building and the resulting impact on the urban network.

## 1.1 Definition of digital architecture

Antoine Picon (2010) defined digital architecture as the use of digital technologies (tools, electronic devices, and systems) in design [8]. Digital architecture helps in designing, developing design and detailed design of the form of architecture, as it is a new trend that is becoming more widespread and expresses a new generation of artistic thought that was reflected in various areas of the urban environment in architectural and urban design projects [9]. Leach Neil (2009) defined it as a new type of engineering architecture that is produced by digital technologies with various emerging architectural styles that express themselves as function and form. Many architects have used new digital technologies to embody their ideas, as digital designs play an important role in the development of architectural design due to their new branches and forms and the way of thinking about the various fields that can arise in it and that facilitate achieving sustainable design [10]. Digital architecture is defined by Koerniawan (2012) as a biased movement from the artwork to the artistic event, from the simulation of reproduction to the simulation itself, from simulation to virtual direction, from interpretation to interactivity, from image to interface, and from order to disorder, and these propositions show that digital technology can simplify and provide aesthetics in architecture through computerized devices and systems that contribute to shaping the changing style that characterizes contemporary architecture. Lankshear and Knobel in Koerniawan Colin (2012) believe that it is a new normative trend that follows the use of computers for education and building professional practice, in addition to the need to emphasize that the time factor in digital design is not limited to the speed of work completion, but rather to the speed of decision-making, evaluation, and determination of problems and challenges before construction, i.e. The speed of performance and prediction of design quality [11]. Digital architecture has brought about a change in the proportions and aesthetic dimensions of contemporary architectural formation due to the capabilities of digitization and its flexible and innovative properties, which have helped in the use of digital formation. This intellectual revolution called for the emergence of a revolution in the world of architectural form, so new and innovative rules have emerged at the level of design, implementation, and achievement of the goals of the creative form, such as renewal and contemporaneity, and the discovery of the inherent relationship between mass and space, in pursuit of change, formal renewal, the appropriate impact on the recipient, and the rules for modifying the digital formation that distinguished digital architecture and emphasized the necessity of integrating architecture with the surrounding environment and urban context to reflect the development of architecture and the culture of the site [12]. The development of software has also affected the output of digital architecture. Under digital architecture buildings are no longer ordinary, as was confirmed by traditional tectonics. instead, they have become a body with life through its vision of buildings as dynamic structures and dynamic spaces [13], and the influence of several types of digital structures have appeared in the urban environment based on basic design concepts such as topological space (topological architecture), similar surfaces (analogous architecture), motion

dynamics and dynamics (animated architecture), key-shaped animation(transforming architecture), parametric design (parametric architecture) and the structure of genetic algorithms, due to fundamental developments in engineering and the use of free and complex forms that have helped transform digitally designed buildings into an urban avant-garde element influential in the city in different periods (ancient, contemporary and future cities) [14][15][16].From this, digital architecture can be defined as interactive architectural formations capable of adapting, dialogue, and the creation of a reciprocal relationship between the physical environment and the recipient. This has changed some traditional architectural and urban concepts and given rise to new concepts such as non-material spaces, flexibility, fluidity, and freedom of formation to create a multidimensional space that integrates time and space, thus generating space _ time, reality and imagination, and a space with spatial value integrated with the fabric of the city, where these formations have enabled the realization of imagination with sensory perceptions and liberated executive processes from spatial determinants, This in turn has enabled breaking out of the familiar style in harmony or contradiction with the context in pursuit of distinction and uniqueness using digital language, computer models, simulation, photography, and programming as a basis to design and create digital shapes and structures.

## 2 THEORY OR (LITERATURE REVIEW)

### 2.1 The impact of digital architecture on the strategic value of the fabric

Digital architecture, with its various dimensions, affected the city and its morphological features. Digital blocks have brought about great changes in urban spaces, and their impact is evident in the changing road network and proportions of land use, which affects its morphological planning, as digital architecture adds spatial features and characteristics to construction sites which have a significant impact on achievement in social, economic and environmental dimensions in the surrounding context [17]. The morphological dimension in contemporary cities has added privileges in light of the new knowledge-technological development, as digital technologies have changed production and liberated the new environment from inevitable laws and the limits of time and space. Digital architecture now constitutes a model of value for this era, from being static to dynamically liberated, from material to immaterial, and from heaviness to lightness and the logical relationship to infinity and clarity to ambiguity, as architecture was restructured according to the contents within the electronic world and the image of structured space [18], The relationship between digital buildings and the traditional city is expanding the boundaries of the city's space by adding digital structures that interact and integrate with its traditional fabric, as these structures spread in the form of separate nodes, occupying important locations in the fabric, which produces distinct landmark points of strategic value. This helps create spaces for the flow of movement (digital space) that interprets the digital city. Digital structures and digital spaces affect the spatial perception of the urban fabric and create many perceptions of the recipient during their movement that strengthen his relationship with the site [19]. Therefore, there is agreement on the importance of sites as spatial centers; when adding distinctive buildings in them, they increase the attractive kinetic and visual forces that work, according to their strengths, to gather angles

of view and directions of movement, increase the property of integration, reduce isolation, and raise the strategic value of the urban fabric in those locations. Digital architecture helps achieve social, cultural, economic, and urban development, as the city is recognized through its vital centers as the center of the wealth of the nation. Understanding the spatial settings of these centers is essential in achieving the economic development of the city, as the addition of digital structures in the city has a major role in integrating disparate fields such as economic geography and trade, with achievement in spatial, perceptual, economic, and social dimension [10] [20]. Hence digital technologies have a major role in reformulating formal relations, that is, the transition from the design of the form to the study of interconnections and relationships in the process of parametric, dynamic, flexible, and nonlinear design that summarizes the design within the determinants of inter-urban contexts and the social and technical influences that define the relationships and the main features of the formulation of forms that are compatible with its overall holistic urban, social, environmental, technical and knowledge context. The relationship has become not only one of mass and space, but rather one in which multiple contextual determinants are linked to produce the morphology of the digital architectural and urban form that sensitively responds to external relations resulting in a functional performance that is as close as possible to perfection and integration [21] [22]. So there is agreement on the importance of sites as spatial centers, and when adding distinctive buildings in them, they increase the attractive kinetic and visual forces that work according to their strength to collect viewing angles and movement directions, increase the feature of integration and reduce isolation, thus raising the strategic value of the urban fabric in those locations and helping to restore their cohesion, as shown in Figure (1).

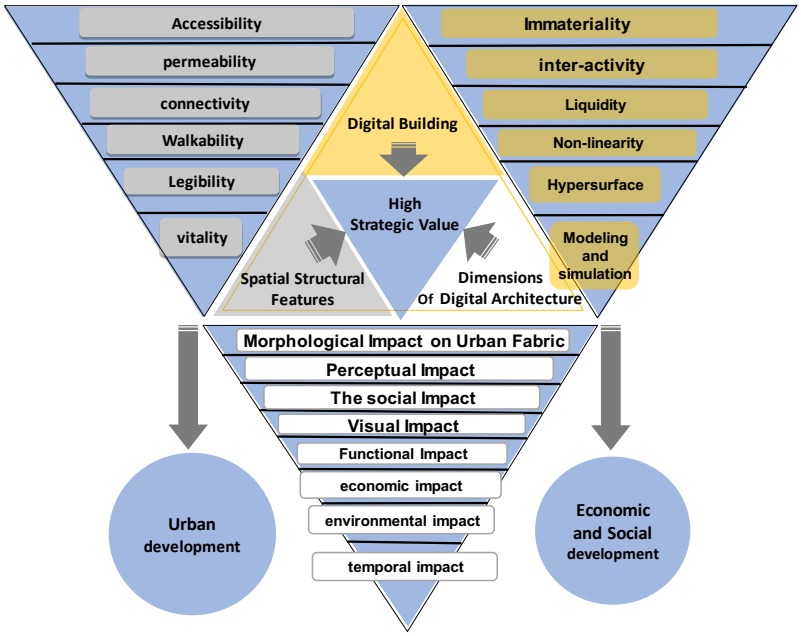


**Figure 1**: The Impact of Digital Architecture on the urban fabric- the researcher's source.

## 2.2 THE STRATEGIC VALUE

Hillier (2009) put forward the importance of strategic value in the city network through its contribution to achieving the vital site, which is achieved by the complex understanding of the structural depth to

achieve integration in the fabric rather than the surface. The spatial strategic value is applied through formulas that appear in the method of space organization at the level of different regions within the urban environment, as this emphasizes the issue of the close connection of the strategic value with the structural, functional, and social considerations of the fabric and the realization of the local integration of the space, this in turn emphasizes the achievement of the comprehensive integration of the city fabric. The strategic value, which is linked to spatial integration, affects traffic flow rates [23], and is considered in regional planning as an important social and economic indicator to influence many decisions related to land use and infrastructure planning, thus creating balanced and integrated spatial nodes that help rebalance the fabric. Alexander (1987) confirmed that the cohesion of the urban fabric is an objective condition for spatial formations, which occur in varying degrees in any part of the space and can be measured by integrating the part with the whole [24] [25]. Van Ness (2002) clarified the importance of the strategic value, which he defined as the spatial value of the site or node, a quantity measured at different degrees of spatial integration of the street and the road networks [26]. In their study Turner et al. (2001) confirmed that the most strategic and preferred locations for selection in the urban fabric are through the end of long corridors or at prominent intersections in streets, which was determined by looking at the relationships at the holistic and local levels to obtain the experience of determining the spatial value (strategic value) for these sites depending on the values of integration [27]. Matthew Carmona, in his study "Place value and the ladder of place quality," emphasized the importance of spatial value and the design conditions of places that add "value" to it, which is the degree to which interference in the built environment affects, whether positively or negatively, the various public policy objectives. He defined this idea as "spatial value" and linked testing the impact of these squares on the quality of the local built environment. This represents a means to evaluate the design of places, as a high-quality place is that achieves the greatest value for its users, i.e. has high strategic value. This means it is characterized by sustainability in healthy, socially rich, and economically productive lifestyles [28]. The strategic value in the urban fabric can be defined as an indicator of the quality of spatial organizations that appear in the spatial organization method of different sites at the level of the urban fabric in particular and at the level of the city in general, emphasizing its close connection with functional, social, economic and environmental considerations and the achievement of local integration of space, which in turn emphasizes the achievement of the holistic integration of the urban fabric.

## 2.1 THE SELECTED SAMPLE "CENTRAL BANK OF IRAQ (CBI) BUILDING IN AL-JADRIYHA

The Central Bank of Iraq building, in Al-Jadriyha-Baghdad, designed by the late architect Zaha Hadid in 2015, as shown in Figure (2)(3), was chosen because it is the first environmentally friendly digital building that has obtained the international Royal Institute of British Architects (PRIA) certificate for environmentally friendly sustainable buildings, and it has also become Baghdad's most prominent architectural and economic landmarks, and a distinctive brand in the Middle East region, reflecting a dynamic parametric design, which is adaptive and exhibits dialogue with its surroundings, It invades

the Baghdad city scene with a design contrading the context and affecting the visual image of the city, In addition its implementation is a reflection of high digital technical progress, whether in its structural form or smart technological materials interfaces. Its reflection of the characteristics of digital architecture are appeared in its design. In terms of urbanicity, the project is located in an important location in Baghdad, Al-Jadriyha area, overlooking the Tigris River and linked to the most important roads that cross the area, which is Abu Nawas Street on the riverside and Al-Karrada Street, inside, parallel to the river. It is also linked to Al-Karrada Street, outside, through the Al-Jadriyha intersection. The site provides accessibility from all four sides, as it is located in the main road intersection area. It is overlooked by the most important bridges, which are the 14th of July Bridge from the right and the Jadriyha Bridge from the left, achieving visual and kinetic clarity for the site. It is located near the Babylon Rotana Hotel and the Coral Village and Hotel, which are considered among the most prominent tourist attractions in the region. The site presents an opportunity to activate pedestrian movement due to the green squares of the Abu Nawas area that overlook the river [33].


**Figure 2**: The site of the Central Bank of Iraq (CBI) building in Al-Jadriyha - the source is www.google.iq

**Figure 3:** Central Bank of Iraq (CBI) building in Al-Jadriyha- the source is the Researcher

## 3 THE PRACTICAL STUDY

To achieve the goal of the research in knowing the effect of the morphological dimension of digital architecture on strategic value, the research relies on the structural analysis method.

### A THE ANALYSIS METHODOLOGY

In this research, the methodology of space syntax is adopted, which is a software-based approach for the abstraction and representation of urban systems [29], with a focus on the role of spatial networks in shaping patterns of social and economic relations Through structural analysis of the street network the relationships between spatial planning and the social, economic and environmental set of phenomena are investigated. These phenomena include patterns of movement, awareness, interaction, land, use intensity, land use mix, and place value [30]. The analysis stage includes the site of Karrada, Al-Jadriyha in 2022, in which aerial photographs and field surveys of the most important buildings and intersections were adopted.


**Figure 4**: Identify the analyzed points in Al-Jadriyha area as shown in Figure (4)
the source is the Researcher

## B TECHNIQUES USED IN THE RESEARCH

An extension was adopted within the Axwomen program through the ArcView GIS 3.3 window to measure indicators of the strategic value of the Central Bank project in Baghdad as a product of the digital architecture, as the texture was analyzed for any changes before and after adding the Central Bank.

### c MEASURING THE STRATEGIC VALUE

Hiller based his study on accessibility as one of the most important principles on which the integration of urban space is based. Through previous studies, the strategic value of the
space site or religious building in this research is calculated by collecting the integration values for all space lines that pass through the urban mass except for the lines that are in contact with its edges [31-32]. Karimi (1997) referred to the feature of integration in the study of spatial structure to measure the degree of relative symmetry, which is called relative depth. The measure of integration is considered one of the most important comprehensive structural measures, and the degree of space integration is measured by calculating the rate of space depth, which ranges between (-0-and 1), where zero is a low degree of depth, while the higher value indicates the greater depth, i.e. isolated areas, and is measured using the following equation:

**Integration value 1 + Integration value 2 + …etc. = Strategic value …… (1)**

## 4 RESULTS OF THE PRACTICAL STUDY

-The results of the analysis data, as can be seen in Figures (5) and (6), concerning the relationship between the Central Bank and the remark points (Babylon Rotana Hotel and Baghdad University Tower) and the intersection points of the main streets, in addition to the streets close to the site,

showed that the sum of the integration values for all the space lines that pass through them (the strategic value) ranged between (-0.09 –and-7.78-) before the establishment of the Central Bank, so the highest strategic value was for the Jadriyha node, which (is-7.78-), the comprehensive integration values for Abu Nawas Street ranged from (1.82-1.86), and the local integration values were (2.8-3.6), while the strategic values for the previously mentioned sites were in the range of (-9.34 -1.69-) after the construction of the Central Bank. The highest strategic value was for the node of the intersection of Al-Jadriyha, which was (-9.34-), and the values of the comprehensive integration of Abu Nawas Street were in the range of (-2.99-3.66-), while the local integration ranged between (-3.91-and-4.27-). see Table (1)

- Through indicators of local and inclusive characteristics, we find that the addition of the Central Bank building has raised the spatial and strategic values of most of the sites and nodes associated with the Central Bank, so that they became within the sites of the nucleus of integration, in addition to raising the integration index of Abi Nawas Street within the urban fabric after it was almost isolated from the urban street network, We notice the positive impact of building CBI on Abu Nawas Street, which confirms the role of digital buildings in the re-integration of parts of the urban fabric by achieving indicators of ease of access, connectivity, and kinetic and visual permeability, which reactivate isolated areas and streets and make them vital and vibrant. see Figures (7)

**TABLE 1:** The values of the strategic value Before and After the central bank site, the significant points, and the intersection of main streets.

| point | The location | Sum of integration= strategic value Before | strategic value before CBI | Sum of integration= strategic value after CBI | strategic value after CBI |
|---|---|---|---|---|---|
| 0 | Central Bank of Iraq | 1.86+1.82 | 3.68 | 2.163+1.377+1.34+1.64 | 5.18 |
| 1 | Jadriyha bridge | 2.12+1.01 | 3.13 | 2.16+1.4 | 3.3 |
| 2 | Tower of university | 0.67+0.64 | 1.32 | 0.88+0.77 | 1.65 |
| 3 | Jadriyha node | 2.10+1.89+2.07+1.85 | 7.87 | 2.16+2.16+2.17+2.85 | 9.34 |
| 4 | Tamoz brdige1 | 1.63+2.10+1.66 | 5.39 | 1.63+2.10+1.66 | 5.39 |
| 5 | Node5 | 1.48+1.61+1.94 | 5.03 | 1.59+1.68+2.11 | 5.35 |
| 6 | Karrada node | 2.62+1.38+2.06 | 6.06 | 2.84+1.97+2.11 | 6.92 |
| 7 | node7 | 1.98+1.21 | 3.19 | 2.11+1.69 | 3.8 |
| 8 | Tamoz brdige2 | 2.01+1.42 | 3.43 | 2.09+1.59 | 3.68 |
| 9 | node9 | 1.45+1.31+1.01 | 4.45 | 1.55+1.59+1.31 | 4.44 |
| 10 | node10 | 1.23-1.45 | 2.68 | 1.51-1.98 | 3.49 |
| 11 | node11 | 1.5+2.0+1.02 | 4.52 | 1.9+2.8+1.5 | 6.2 |
| 12 | node12 | 2.2+1.48 | 3.68 | 2.8+1.92 | 4.72 |
| 13 | node 13 | 1.3+1.3+1.1 | 3.7 | 1.9+1.9+1.5 | 5.3 |
| 14 | node 14 | 1.09 | 1.09 | 1.26 | 1.26 |
| 15 | node15 | 1. 8+1.06 | 2.86 | 1.51+1.53 | 3.04 |
| 16 | Rotana Babylon | 1.1+1.2 | 2.3 | 1.6+1.7 | 3.3 |

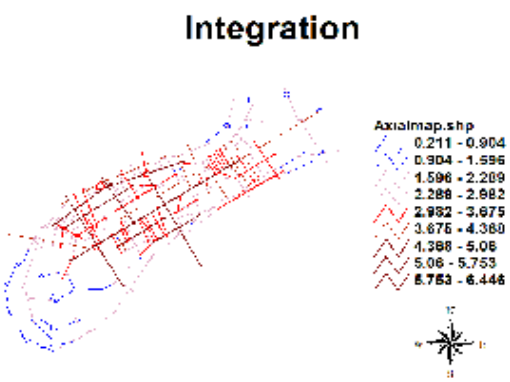


**Figure 5**: the result of strategic value before CBI, by Axwomen, ArcView GIS program- the researcher's source

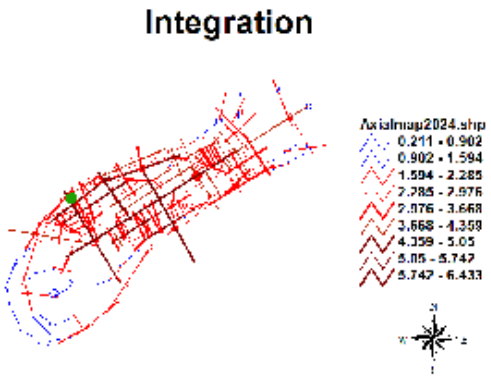


**Figure 6:** the result of strategic value after CBI, by Axwomen, ArcView GIS program- the researcher's source

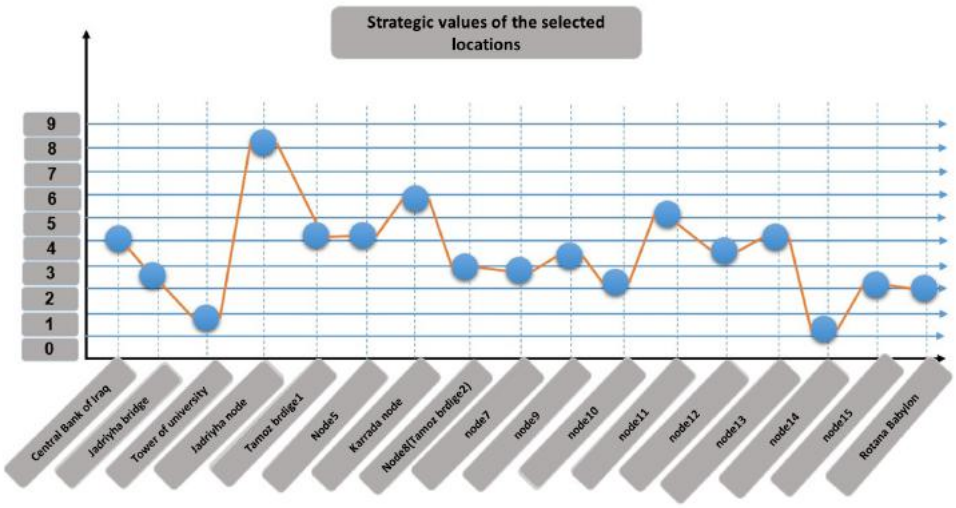


**Figure** 7**:** A chart showing the strategic value of the selected positions, the researcher's source

## 5 CONCLUSIONS

- **Digital technologies affected** the shape of buildings, producing virtual shapes and complex physical structures using digital technologies and transformational designs, moving, fractal, fluid, twisted shapes that simulate morphological and topographical characteristics, parametric shapes with organic blocks inspired by nature and affecting the aesthetic dimensions of the city, and achieving developments at the environmental, economic, social, cultural, and aesthetic levels of the city.

- **Digital architecture is characterized** by flexibility and fluidity, as its influence is transmitted to the surrounding space (urban fabric) through factors of the external environments, so the dynamic form affects the surroundings through organic flexibility, structural architecture patterns, flexible space, and integrated spatial value, and breaking the boundaries of fluid space with the fabric, This result in the

creation of a multi-dimensional topologically variable space (cyberspace) with a fourth dimension that integrates time and space (space-time) due to the emergence of the significant role of technological empowerment of digital architecture in urbanization, in turn helping people redefine their environment by moving from existence (the physical environment) to the virtual world (immaterial environment), as digital culture influences the way society perceives cities to be a mental map that helps them discover urban spaces and creating new forms of digital structures and spatial arrangements, thus achieving interdependence with the streets (paths) and the public (the recipients).

- The strategic value is considered one of the basic features in achieving integration of the urban fabric, as the site of high strategic value provides integration of local and comprehensive characteristics, which affects the economic, social, and environmental aspects, achieving urban development that contemporary cities call for.

- **Clarifying the influence** of digital architecture in the city and its morphological features, the great changes brought about by digital blocks in urban spaces, and the change in the road network and the proportions of land uses, which affect the planning, spatial, and strategic value of the digital architecture through the impact of its different dimensions on the urban context.

- **Digital architecture impacts** on spatial value morphologically, perceptually, visually, functionally, socially, economically, and environmentally, which raises its strategic spatial value and restores its cohesion with the urban fabric. It has a major role in reviving parts of the urban fabric to achieve the economic, social, and environmental development that leads to urban sustainability. - **Clarifying** the effect of adding the Central Bank of Iraq building to the urban fabric of the city of Baghdad in raising the strategic values of most of the nodes and sites associated with the site of its establishment, and its great role in raising the value of the local and Global integration of Abu Nawas Street after it was noted that the values of its integration declined and fell within the nucleus of isolation from the fabric before the establishment of the Central Bank because of its lack of vital activities and functions that promote social integration, attract tourists, and facilitate economic development, despite its strategic location in terms of the river and its connection to the most important roads.

## 6 RECOMMENDATIONS

Through the scientific study and measuring the strategic value of the central bank site as the first digital building in the city of Baghdad, the results of this research indicate the importance of recommending to the governmental and local concerned authorities the need to study and choose the location of sites for digital architecture in the urban fabric for urban development projects because of their great impact in adding features and the characteristics of the sites in contributing to raising their strategic value, which leads to the re-integration of degraded areas and their cohesion with the urban fabric, which facilitates urban development in the long term.

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