Al-Azhar Engineering 16th International Conference

Vol. 19, No. 72, July 2024, 291 - 313

STUDYING THE IMPACT OF USING THE DYNAMIC CONFIGURATION FOR BUILDING USERS AND OCCUPANTS OF EXTERNAL COURTYARDS

Anessa H.Abou Elwafa*, Hesham A. Sobh, Algendy S. Abdelghany

Architecture Department, Faculty of Engineering, Al-Azhar University, Nasr City,Cairo,Egypt,

***Correspondence:** nogahassan49@gmail.com

Citation:

A.H. Abou Elwafa, H.A. Sobh and A.S. Abdelghany, " Studying the impact of using the dynamic configuration for building users and occupants of external courtyards", Journal of Al-Azhar University Engineering Sector, vol. 19, pp. 291 - 313, 2024

Received: 22 November 2023

Revised: 30 December 2023

Accepted: 06 January 2024

DOI:10.21608/auej.2024.257744.1550

ABSTRACT

The research deals with the concept of dynamic configuration as a new concept for raising the efficiency of spaces, as it is considered an architectural vision based on the dynamics of movement, and helps to achieve integration between the various systems that make up the external elements in urban spaces, and achieve comfort through the use of integrated energy systems, and obtain the greatest degrees of benefit from energy sources. Natural energy, and the research emphasizes the use of smart systems, as they have the ability to respond quickly to stimuli from the internal and external environment, as they increase consumption efficiency and save energy within spaces. The research also emphasizes the application of requirements and design standards for the use of dynamic configuration in spaces according to the variables of technological development Continuous. A presentation was presented on dynamic architecture and human needs and their impact on the use of dynamic configuration. An analytical study of some models of dynamic architecture was discussed and a proposed strategy was reached towards raising the efficiency of architectural and urban spaces using dynamic configuration.

KEYWORDS: Dynamism , Dynamic architecture , Dynamic configuration , The aesthetic and implementation concept of dynamism , Smart building materials , Design requirements used , Design standards.

دراسة أثر استخدام التكوين الديناميكى لمستخدمى المبانى ولشاغلى الساحات الخارجية

أنيسة حسن محمد أبوالوفا، هشام أحمد محمد صبح، الجندى شاكر عبد الغنى

قسم الهندسة المعمارية بكلية الهندسة جامعة الأزهر، مدينة نصر، القاهرة ، مصر

البريد الاليكتروني للباحث الرئيسي : nogahassan49@gmail.com

الملخص

يتناول البحث مفهوم التكوين الديناميكى كمفهوم جديد لرفع كفاءة الفراغات ، حيث يعتبر رؤية معمارية تعتمد على ديناميكية الحركة ، ويساعد على تحقيق التكامل بين الأنظمة المختلفة والمكونة للعناصر الخارجية فى الفراغات العمرانية ، وتحقيق الراحة من خلال استخدام النظم المتكاملة للطاقة ، والحصول على أكبر درجات الاستفادة من مصادر الطاقة الطبيعية ، ويؤكد البحث على استخدام الأنظمة الذكية ، حيث أن لها القدرة على الإستجابة السريعة للمحفزات من البيئة الداخلية والخارجية ، حيث تزيد من كفاءة الاستهلاك وتوفير الطاقة داخل الفراغات ،كما يؤكد البحث على تطبيق المتطلبات والمعايير التصميمية لاستخدام التكوين

الديناميكى فى الفراغات طبقا لمتغيرات التطور التكنولوجى المستمر ،وقد تم عرض تقديم عن العمارة الديناميكية والاحتياجات الانسانية وتأثرها باستخدام التكوين الديناميكى ، والتطرق إلى دراسة تحليلية لبعض النماذج العمارة الديناميكية و الوصول إلى وضع استراتيجية مقترحة نحو رفع كفاءة الفراغات المعمارية والعمرانية باستخدام التكوين الديناميكى .
الكلمات المفتاحية : الديناميكية ، العمارة الديناميكية ، التكوين الديناميكى ، المفهوم الجمالى والتنفيذى للديناميكية ، مواد البناء الذكية،المتطلبات التصميمية المستخدمة ، معايير تصميمية .

1. INTRODUCTION

The research aims to study the impact of the change occurring in the use of the dynamic configuration in the public space on the occupants, whether the occupants of buildings in public or private spaces or the occupants of the outdoor courtyards and their enjoyment of the urban variable of the surrounding environment, whether the result is in changing the facades of the buildings that they view, or the presence of a dynamic element. Another element in the public space is the elements of the general coordination of the space, such as fountains and urban works of art, as the idea of movement in architectural design is of great importance in its psychological, environmental and aesthetic implications for the occupants of buildings and external squares.

When applying kinetic dynamic systems (dynamic architecture) in architectural and urban spaces using technological tools and computer programs for design and using the outputs, advantages and ideas of dynamic architecture and dynamic composition; Thus, we can reach an increase in the efficiency of architectural and urban spaces, and the more we are able to create spaces that enjoy flexibility of movement while preserving the quality of the internal environment in a positive way, the more we can benefit from this study to raise the efficiency of traditional and non-traditional buildings and raise the efficiency of the general site and internal spaces.

Projects that are characterized by dynamism give the design many advantages, such as pleasure and sensory excitement, as movement represents a change in the position of the image.

Dynamic composition is used to solve the problems of an entire building and generate energy, as dynamism does not stop when any disaster occurs, such as an automatic clock.

The research methodology is based on conducting a theoretical study of two parts (dynamic architecture and kinetic dynamic systems used to raise the efficiency of architectural and urban spaces) with the aim of producing a database of kinetic dynamic systems used to raise the efficiency of architectural and urban spaces, and identifying a set of design considerations and requirements for the functional aspect of movement, utility, technology and beauty. Determine the most appropriate study to rely on in the analytical study, which includes an analytical study to simulate the dynamic movement of a group of local and international buildings and urban spaces, and determine the design standards for dynamic spaces to raise efficiency, to complete the elements required to achieve a proposed strategy towards raising the efficiency of architectural and urban spaces, in accordance with the results of the study. Analytical analysis to raise the efficiency of architectural and urban spaces.

2. Dynamic concept

“Dynamic” is a term of Greek origin that means forces as indicated by foreign references, while in Arabic dictionaries it means “movement, growth, activity, continuity...etc.” [1]. dynamism is external or internal forces that change behavior over time. In general, it represents transformation and transition from one state to another, which requires space and time in which the movement is accomplished.

Dynamics and movement are considered synonymous with one concept. Dynamics include movement over time. Movement here may occur objectively in the visual field and be realistic dynamic movement, or occur mentally through the process of perception and be static movement, or both together. Time here is included in all cases where the natural formation of shapes is subject to two movements. There are two fundamentals that determine the final form of the formation: an internal movement driven by growth and an external movement stemming from surrounding factors. [2].

2. Dynamics science

"It is the science that studies the movement of bodies and what are the forces and effects that produce or affect the body and cause the movement" [3].

3. Dynamic architecture concept

Dynamic architecture is a new perspective in the world of architecture, as dynamism results from the change in time and the entry of the fourth dimension into the design, which is time, so the design becomes four-dimensional (length, width, height, and time), as kinetic architecture is only concerned with the transformation and movement of buildings and works to form a relationship between the internal environment The relationship between the building and the external environment can be summarized as the response of the building or one of its components to the surrounding changes caused by natural factors such as solar energy [4].

"It is the most common and widely used form of kinetic architecture. It includes the movement of the elements contained in the building and integrated with its spaces. The movement in it has nothing to do with the structural structure of the building as a whole, despite its ability to control the general context of the building, such as the movement of partitions, furnishing elements, moving ceilings, etc.." [5].

3.1. Dynamic aesthetic concept

It represents a new vision for the human being in terms of the buildings rotating around themselves to provide distinct views and to fully enjoy the natural appearances to provide new high-tech services. This concept emphasizes that the space in which the human being lives must be dynamic and capable of being modified and changed according to the human needs [6].

3.2. The operational concept of dynamism

Dynamic architecture requires tremendous technological development and high implementation costs, and between this and that, this concept seeks to find a place on the ground, but there remain determinants and restrictions that give privacy to the possibility of application in any place, represented in (implementation, technology, laws, organization, cost), but they In the end, it does not stand in the way of application, and the concept of dynamic architecture remains a concept that represents a new thought that has grown and developed with the scientific renaissance and technology occurring now [7].

Fig.1.shows the links between mobile technology and architecture.

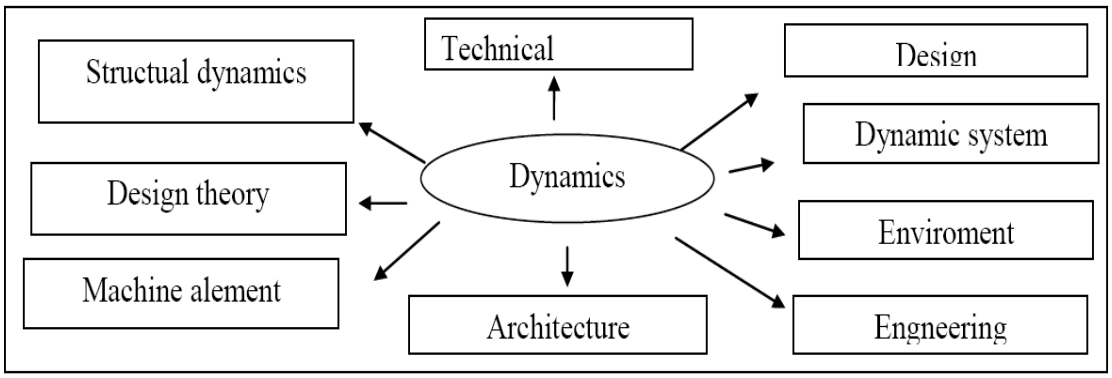


Fig. 1. Links between technology and architecture.

4. RESULTS AND DISCUSSION

4.1. The actual components of the dynamic composition used in architectural and urban spaces

A - The moving unit: It is the moving element located on the outer shell of the building, inside the building, or outside the building, and it is considered an aesthetic element.

B - The motor: It is the element attached to the moving unit, but in a hidden, unclear form. It is connected to the power source, where it works to transfer movement to the moving unit.

T - Sensors: Highly sensitive devices with a great ability to measure the extent of change in climatic and environmental conditions inside and outside the building.

D - Control system: An integrated unit of comprehensive control and management of movement practices in the kinetic envelope, by receiving the database coming from sensors and monitoring devices in the form of inputs, so that a group of programs can begin processing these inputs and translating them into outputs, which are movement commands directed to the engine to move the moving unit. Installed or integrated on the outer shell, this is according to a prior strategy and pre-programmed commands [8].

Fig.2. shows the actual components of the dynamic configuration.

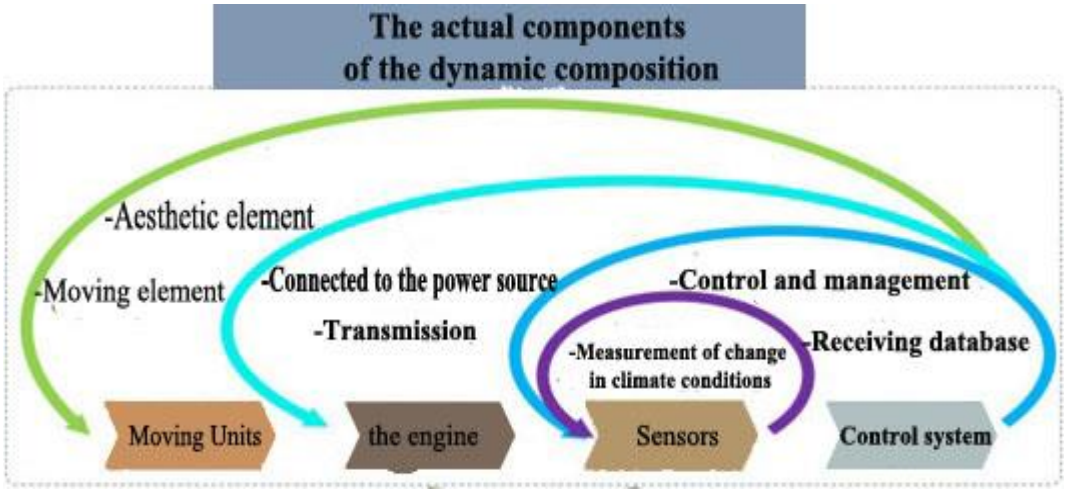


Fig. 2. The actual components of the dynamic configuration

4.2. Design requirements for the dynamic configuration of spaces

The elements of the design requirements used in the dynamic formation of spaces can be summarized in three elements, which are (smart materials used in the construction process - smart systems that are controlled through building management - use of the smart outer shell, as it is considered the link between the architectural spaces inside and the urban spaces outside [9].

4.2.1. Smart building materials used in shaping the dynamic composition

Smart materials are defined as materials that have the ability to respond to stimuli from the internal and external environment. These materials have the ability to sense and adapt to different stimuli, and these stimuli may be electrical, chemical, or magnetic [10].

Fig.3. shows the characteristics of smart building materials used in forming the dynamic configuration.

Fig. 3. the characteristics of smart building materials used in forming the dynamic configuration.

4.2.2. Types of smart systems used in the dynamic formation of spaces

Smart systems are defined as the physical part represented by the control switches and communication channels, which play an important role in the building's economics and how it deals with them [12] These systems work to monitor and monitor most of the building's services depending on the level of integration and development in the building, as These systems contribute to energy conservation, implementing the best security and safety system for the building, and providing a database and audio-visual communications systems. The use of smart systems helps

raise the efficiency of architectural and urban spaces and rationalize energy consumption, and they are divided into (control and access control systems - direct digital control systems - communications systems).

First: Access control and monitoring systems

Control systems are used through automatic control, where a computer network linked to electronic devices is used to achieve a building automation system where the climate is controlled inside the spaces, monitoring the performance of all systems inside the spaces and sending alerts to the maintenance crew, and using an energy management system where the performance of the power generation system is controlled. Reducing consumption, using a central control system that monitors the building's mechanical and electrical equipment, and also using a facility management system that coordinates work between individuals, spaces, basic infrastructure, and energy services. These systems facilitate the ease and flexibility of managing spaces. **Fig.4.** shows the design requirements for using control and access control systems [13].

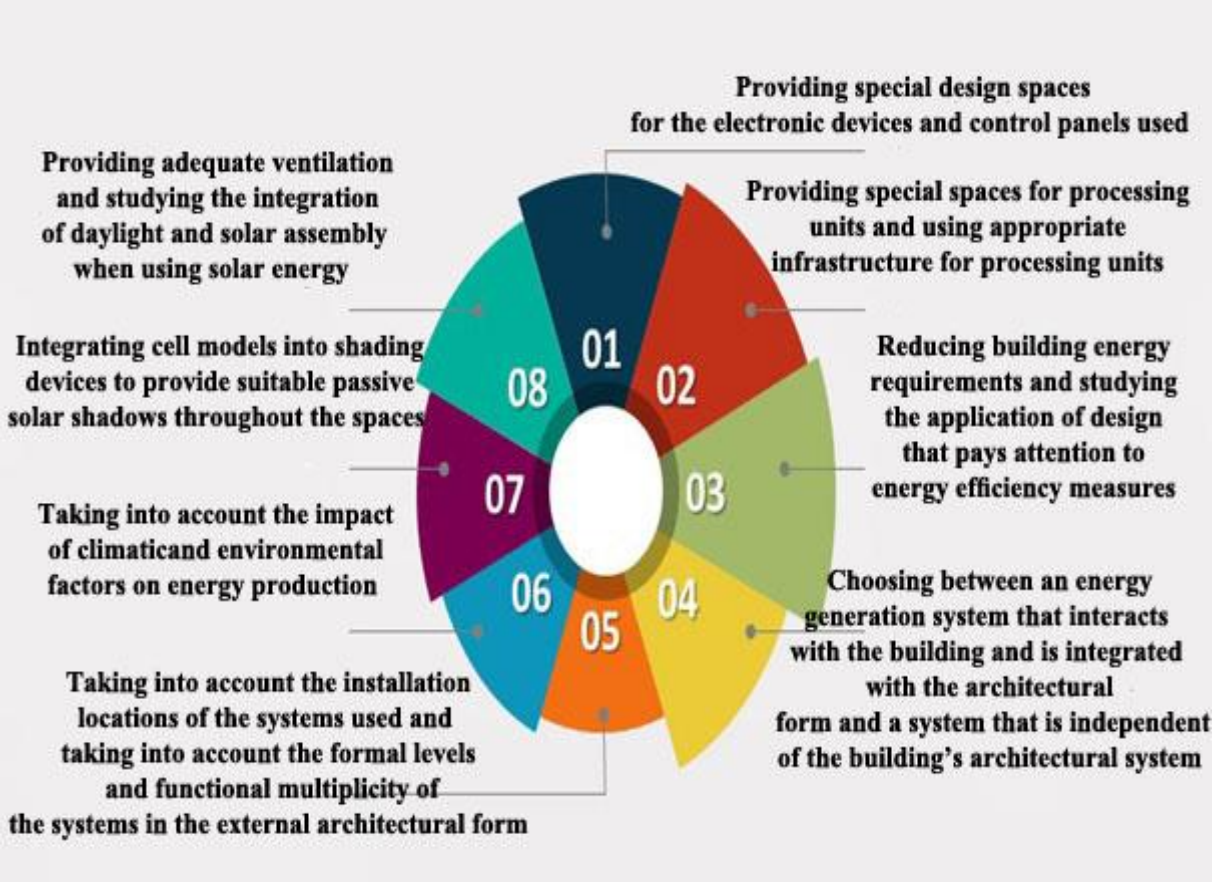


Fig. 4. the design requirements for using control and access control systems

Second: Direct digital control systems

It is a control system for building services, where the systems are controlled through controllers and microprocessors, and programs are used that analyze the processes, as the sensors receive and analyze the information, where the response is sent to the control units. These systems are also linked to programs that analyze the data, make graphs, and follow up. User control processes [14].

Fig.5. shows the design requirements for using direct digital control systems

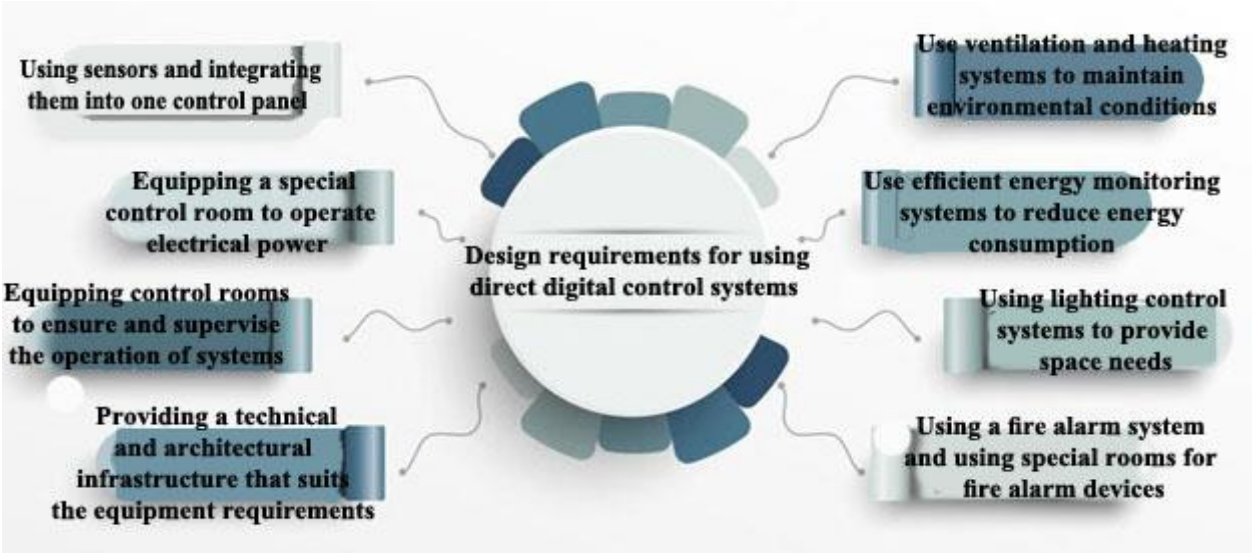


Fig.5. the design requirements for using direct digital control systems

Third: Communications systems

The process of linking systems, exchanging data, and achieving integration is carried out using smart communications systems, to achieve increased efficiency of architectural and urban spaces. As this integration helps in the maintenance process, ease of operation, and achieving interconnection between systems to obtain the lowest cost and highest efficiency [9].

Fig.6. shows the design requirements for using communications systems.

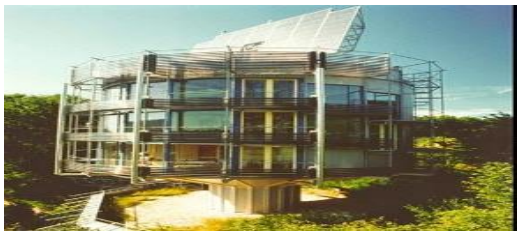
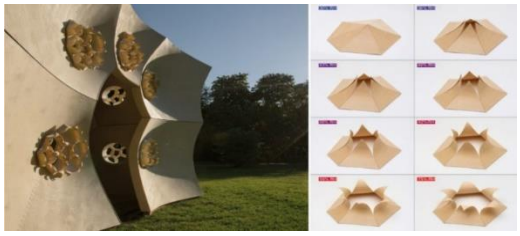
Fig.6. the design requirements for using communications systems.

4.3. Design requirements guide to study the impact of using the dynamic configuration for building users and occupants of external courtyards

The research will address a study to establish design requirements and standards for the use of dynamic configuration in architectural and urban spaces to raise efficiency, and facilitate the process of evaluating the level of performance of architectural and urban spaces, by developing

a plan to evaluate the performance of dynamic spaces, and identifying the points used in setting the final design requirements for dynamic architectural and urban spaces, Will be presented in **Table**. **1**

Table 1. Guide to design requirements for using dynamic configuration in spaces

A guide to design requirements to study the impact of using the dynamic configuration for building users and occupants of external courtyards	
A - The goal of setting design requirements for using dynamic configuration in spaces	• Helping the architect to develop a specific guide for determining the level of energy saving. • Developing a specific guide to achieve sustainability for dynamic spaces. • Study the impact of using the dynamic configuration for building users and yard occupants and achieving human needs through • Achieving thermal comfort by controlling solar energy through • Use materials that respond to the temperature of the surrounding environment [4]. • Using materials that respond to electrical current and whose properties can be controlled, whether in shape or color, such as windows Sage electrochromic glass, shown in **Fig. 7.**  **Fig.7**.sage electrochromic glass https://www.sageglass.com • Controlling the orientation of the building through the climate suit and accordingly controlling the amount of direct solar gain, such as a heliotrope house.  **Fig.8**. Heliotrope house https://ar.wikipedia.org • Achieving moderate humidity through the use of hydrophobic materials, as the behavior of these materials can change when they absorb moisture.  **Fig.9**. Pavilion Meteorosensitive HygroSkin https://www.sciencedirect.com/ • Achieving shading through • Use movable shades. • Use of moving skins for facades. • Using the active reaction of polymers, where they change their shape when exposed to electrical energy and convert it into kinetic energy. • Using the Smart Screen system as it works as a shading system for the facades.

<table>
<tr><th colspan="2">A guide to design requirements to study the impact of using the dynamic configuration for building users and occupants of external courtyards</th></tr>
<tr><td>A - The goal of setting design requirements for using dynamic configuration in spaces</td><td>

Achieving natural ventilation using dynamic configuration through
Using moving elements in the interfaces.
Using smart materials that vary in permeability, as they adjust the openings in the interface depending on carbon dioxide gas.
Using an intelligent system that depends on the properties of materials.


Fig.10. The dynamic envelope of Q1.Building[15].

Achieving visual comfort through the use of smart materials that provide natural lighting.
Achieving acoustic comfort through the use of double glazing and the use of mobile breakers.
Obtaining the largest amount of energy through building movement, wind energy, solar energy, and utilizing water sources.
Achieving the aesthetic dimension in stability and movement.
Achieving safety through the use of smart security systems.
Keeping pace with the area surrounding the buildings culturally and socially.

</td></tr>
<tr><td>B- Steps to determine design requirements</td><td>

Determine the design criteria points through

Knowledge of solar acquisition systems.
Identifying renewable energies in dynamic spaces.
Knowing the level of energy saving in vacuums.

Determine the form and format of the practical guide for the design requirements through:

Identify all the characteristics and qualities that must be available in dynamic, energy-saving spaces.
Formulating design standards in a specific practical guide to assist architects in the selection process in designing dynamic spaces and buildings.

</td></tr>
<tr><td>T- Evaluating the performance of dynamic spaces</td><td>

Conducting theoretical and practical studies that demonstrate the importance of using dynamic configuration in architectural and urban spaces to achieve the goals of using dynamic architecture.
Using methods to evaluate the performance of dynamic spaces through
The method for estimating the use of dynamic configuration in spaces depends on the factors associated with the steps of space design, and the use of specific metrics to evaluate smart dynamic spaces in general.
Computer simulation method. This method relies on matching data during the operation of dynamic architectural and urban spaces.
The method of managing services and facilities, which depends on the service of specialists to facilitate the dynamic design and achieve its goals, and is used in all stages of the building’s life.

</td></tr>
</table>

The use of dynamic configuration in architectural and urban spaces helps to achieve integration between the various systems that make up the external elements in urban spaces, and achieve many human needs and helps to achieve balance when making use of natural and artificial

lighting and achieve comfort for users of spaces through the use of integrated energy systems, and obtain greater Degrees of benefit from natural energy sources. The research emphasizes the use of smart systems in the dynamic configuration of architectural and urban spaces, as smart systems have the ability to quickly respond to stimuli from the internal and external environment and adapt to them and have the ability to perceive, and also the use of smart materials as they increase Consumption efficiency and energy saving within spaces. The research also confirms the commitment to achieving the design requirements for using dynamic configuration in architectural and urban spaces, and applying these requirements in accordance with the variables of continuous technological development every day to raise the efficiency of architectural and urban spaces.

4.4. Analytical study

The research deals with the analysis of some models used for dynamic configuration that achieve the objectives of the study in accordance with the previous design requirements of achieving human needs to raise the efficiency of architectural and urban spaces.

The study sample .

- High Court of justice and Supreme Court
- Al Bahr Tower
- Head of Franz Kafka
- Umbrellas of the Prophet's Mosque.

Table .2 Analytical study of the building of the high court of justice and supreme court

Basic standards for increasing the efficiency of architectural and urban spaces using the dynamic configuration of the outer roof envelope of the high court of justice and supreme court buliding	
General description of the building	• Building type: administrative (Regional Court of Appeal, Supreme Court). • Location: Madrid_Spain. • Establishment date 2006-2011. • Total building area: 45,000 m2. • Architectural designer: Norman Foster • Motion cover designer: Hoberman [8].
Architectural description of the building	• It consists of two adjacent buildings, which are the Court of Appeal and the Supreme Court. • The Court of Appeal is a cylinder in shape consisting of 3 floors with an undulating facade. • In the middle is an atrium that penetrates the building and is topped with a glass roof. • Offices were distributed around the building, along with meeting rooms, to wrap around the atrium. • The Supreme Court is located in a smaller circular building. • Next to the Court of Appeal, the building's mass is interspersed from the outer frame by a wedge-shaped opening that forms a long entrance and expands into a triangular atrium [8]. 

	Fig.11. high court of justice and supreme court architecturaldesignschool.com
Basic standards for increasing the efficiency of architectural and urban spaces using the dynamic configuration of the outer roof envelope of the high court of justice and supreme court buliding	
Dynamic formation of the outer shell	• It is a modular surface. This surface consists of a series of movable aluminum strips. • The slats can be assembled to disappear optically within a void formation in the main lattice structure carrying the slats, in order to allow the entry of solar radiation. • Each chip is controlled by a dynamic motor that is integrated with sensor systems.  **Fig.12.**The dynamic roof of the court building (fosterandpartners.com)
A- **Impact on natural lighting**	• Folding the external dynamic grid roof into a void formation in the main grid structure that contains aluminum strips helps reduce unwanted solar radiation. • Allow natural daylight to provide natural lighting.  **Fig13.** the effect of the dynamic courtyard on natural lighting (fosterandpartners.com)
B- Effect on shading	• The movement of aluminum strips in the roof of the building envelope works as an essential part of controlling shading within the building spaces during the folding and movement process.  **Fig.14.** the effect of the dynamic courtyard on the percentage of internal shading (fosterandpartners.com)
H- Effect on ventilation	• Controlling solar radiation to reduce the heat gain process and controlling the reduction of glare through the movement of aluminum strips in the roof of the building envelope.

	• Controlling air flow inside the building. • Control internal natural ventilation.
X- Effect on temperature	• The dynamic atrium, when opened and closed, acts as a tank that stores cool air at night to combat the heat during the day.

Table 3. An analytical study of the Al-Bahr Towers building.

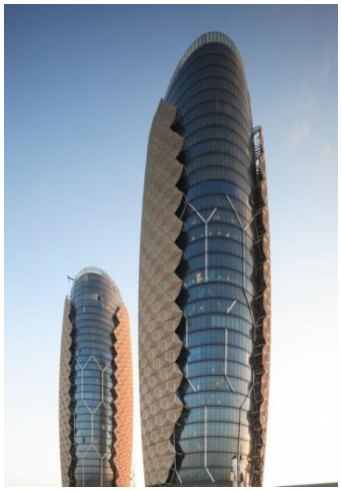
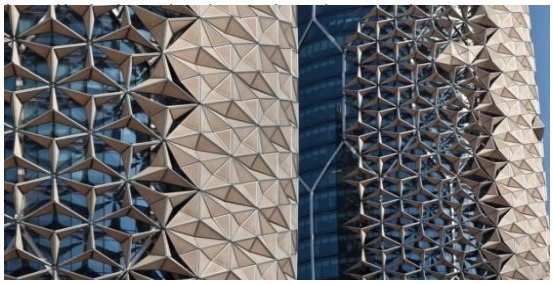
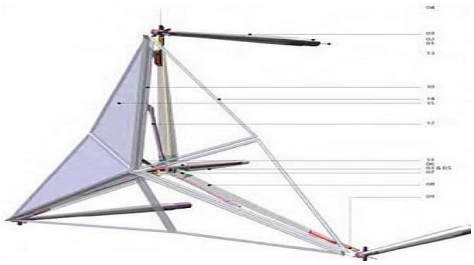
An analytical study of the Al-Bahr Towers building	
General description of the building	• Administrative building • Location: Abu Dhabi - United Arab Emirates • Establishment date 2012 • The total area of the building is 56,000 square meters • Architectural designer Aedas [8].
Architectural description of the building  **Fig.15.** AL Bahar Office Towers (architecturaldesignschool.com)	• It consists of two towers, 140 meters high, with 22 floors. • It features a structure inspired by beehives and automated dynamic solar screens that respond to the movement of the sun. • It contains a number of mobile umbrellas that may be 1000 units. • Solar screens respond dynamically and automatically to the angle of the sun. • Using a structural system that simulates hexagonal bee houses, in which a cantilever structural system was installed to the basic structural system of the building, and on it the curtain wall was  **Fig.16.** Dynamic solar panel installation (architecturaldesignschool.com)
Dynamic formation of the outer shell	• Each unit is 2.2*3.2 m in size. Each unit is divided into 3 internal triangles. • The weight of the unit is about 32 kg. • The casing moves each unit with a dynamic piston that tracks the reaction resulting from the control system through sensors as a result of prior programming. • It was calculated according to the climatic conditions outside the building [16].  **Fig.17.** Dynamic unit (architecturaldesignschool.com)

Table .4 Basic criteria for increasing the efficiency of architectural and urban spaces using the dynamic configuration of the external envelope of the Al Bahr Tower building.

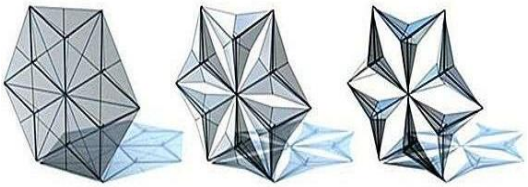
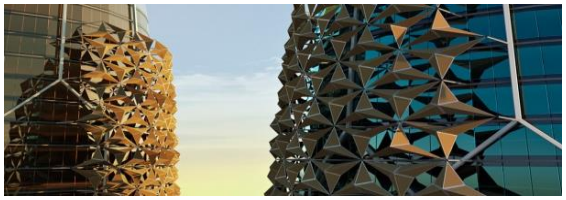
Basic criteria for increasing the efficiency of spaces using the dynamic configuration of the outer shell of the Al Bahr Tower building	
A- Impact on natural lighting	• Providing lighting ranging from 240 lux, which are the studied values appropriate for the administrative spaces pre-programmed for this space during work periods. • Limit the use of artificial lighting and reduce energy consumption and operating loads of industrial air conditioners [17].  **Fig.18.**The stages of opening and closing the units and the effect of lighting internally (architecturaldesignschool.com)
B- Effect on shading	• Dynamic units form a number of angles that respond to the movement of the sun • Solar panels reduce the exposure of external facades to solar radiation.  **Fig.19.** Dynamic cells during opening and closing and their effect on solar radiation (architecturaldesignschool.com)
C- Effect on temperature	• The dynamic configuration of the building's outer envelope works to move the dynamic units. • The dynamic units move as a result of the presence of a dynamic piston, and this piston follows the process of opening and closing. • Dynamic units work to reduce direct solar radiation and reduce heat gain, with a maximum value of 200 watts per meter. • Protect dynamic units using sensors installed on them [16].
D- Effect on ventilation	• Dynamic solar panels begin to shut down when exposed to solar radiation. • Dynamic movement prevents direct solar radiation during work periods. • Maintaining the ventilation of the space. • Reducing energy consumption.

Table .5 Analytical Study of the Head of Franz Kafka Sculpture

Analytical Study of the Head of Franz Kafka Sculpture	
General Description of the Head of Franz Kafka Sculpture	• Location: The twisted and reflective statue is located behind the Quadrio shopping center on Národní třída (National Street), Šarapova Street, Prague – New Town. • Construction: The rotating head was built by David Černý in 2014. • Cost: The cost was 30 million Czech crowns, invested by the CPI Property Group. • The statue is a tribute to the writer Franz Kafka. • The moving head symbolizes the complex mind of Franz Kafka, who was a brilliant writer, but was also a somewhat troubled person. (https://en.wikipedia.org/wiki/Head_of_Franz_Kafka)
Architectural Description of the Head of Franz Kafka	• Construction: The sculpture is made up of 42 rotating layers. Each layer is made of stainless steel and is 0.3 meters thick. • Height: The sculpture is 11 meters tall. This makes it a large and imposing presence. • Materials: The sculpture is made of 24 tons of stainless steel. The stainless steel is polished to a mirror finish, which creates a reflective and shimmering effect. • Weight: The sculpture weighs 39 tons. The weight is distributed as follows: o 24 tons of stainless steel o 9 tons of cables and machinery  **Fig**.**20.** A sculpture of Franz Kafka's head https://en.wikipedia.org/wiki/Head_of_Franz_Kafk
The structure of the Franz Kafka Head Statue	• The head is made of bronze. It is a life-size depiction of Kafka's head, with a furrowed brow and a thoughtful expression. • The head is mounted on a rotating base. This allows the head to turn 360 degrees, giving viewers a different perspective on Kafka's face • The statue is made of bronze, a metal that is known for its strength and durability. This makes it a suitable material for a public sculpture that is exposed to the elements. The bronze is also polished to a high shine, which gives the statue a reflective quality that enhances its appearance. • The statue is located in the center of Prague's Old Town Square, a popular tourist destination. The square is surrounded by historical buildings, including the Old Town Hall and the Charles Bridge. The statue is a prominent landmark that is visible from many points in the square. • The movement of the statue is powered by motor units connected by cables. (https://en.wikipedia.org/wiki/Head_of_Franz_Kafka) • The internal cables are over one kilometer long and the individual layers move thanks to 21 different motors.

<table>
<tr><th colspan="2">Analytical Study of the Head of Franz Kafka Sculpture</th></tr>
<tr><td>The structure of the Franz Kafka Head Statue</td><td>

The maximum rotation speed for each layer is 6 revolutions per minute.
The rotation of Kafka's head is similar to the gears of an astronomical clock. Like the thoughts in the head, the Franz Kafka statue rotates by itself whenever it wants, which makes watching it more interesting.
The head layers move randomly in different directions every hour for 15 minutes. The layers do not always return to their original position, so each time the head has a different shape. This represents the different thoughts in Kafka's head and perhaps the mixed ideas and themes in his work.
The Franz Kafka statue is also a fountain called Metalmorphosis. The fountain is designed to help humidify the urban space, and the movement of the head layers helps to disperse water vapor.
The layers of the statue were also designed to be energy efficient. Once the layers start moving, their kinetic energy keeps the rest of the layers moving. This means that the statue requires less energy to operate than a traditional fountain.
The entire statue must be maintained every two weeks. This includes cleaning the statue, checking the motors and cables, and making any necessary repairs. (https://en.wikipedia.org/wiki/Head_of_Franz_Kafka)


Fig.21.Metalmorphosis sculpture of Franz Kafka in Prague
https://en.wikipedia.org/wiki/Head_of_Franz_Kafk
</td></tr>
<tr><td>Franz Kafka's Head Statue and Environmental Needs</td><td>
Franz Kafka's Head statue is associated with environmental needs in several ways.

First, the statue symbolizes the importance of water in human life. Water is an essential element of life, and it is necessary for human survival. Water is often scarce in some parts of the world, and it can be difficult to access. The statue symbolizes the need to protect water and ensure that it is accessible to everyone.
Second, the statue symbolizes the importance of beauty in human life. Water is often associated with nature and beauty. The statue symbolizes the need to protect the environment and preserve its beauty.
Third, the statue symbolizes the need for environmental responsibility. Kafka's works often deal with philosophical and existential themes, which raise questions about the relationship between humans and nature. The statue symbolizes the need to be more aware of our impact on the environment and take steps to protect it(https://en.wikipedia.org/wiki/Head_of_Franz_Kafka).

</td></tr>
</table>

Analytical Study of the Head of Franz Kafka Sculpture	
Franz Kafka's Head Statue and Environmental Needs	**Some specific examples of how Franz Kafka's Head statue is associated with environmental needs include:** • The statue can symbolize the need to conserve water. It can inspire people to think about how to reduce their water use in their daily lives. • The statue can symbolize the need to protect water sources. It can inspire people to support efforts to protect rivers, lakes, and oceans. • The statue can symbolize the need for innovation in the field of renewable energy. It can inspire people to think about how to use renewable energy to conserve water resources. (https://en.wikipedia.org/wiki/Head_of_Franz_Kafka)
Franz Kafka's Head Statue and Human Needs	**Franz Kafka's Head statue is associated with human needs in several ways**. • First, the statue symbolizes the importance of water in human life. Water is an essential element of life, and it is necessary for human survival. Water is often scarce in some parts of the world, and it can be difficult to access. The statue symbolizes the need to protect water and ensure that it is accessible to everyone. • Second, the statue symbolizes the importance of beauty in human life. Water is often associated with nature and beauty. The statue symbolizes the need to protect the environment and preserve its beauty. • Third, the statue symbolizes the importance of meaning in human life. Kafka's works often deal with philosophical and existential themes, which raise questions about the meaning of life and human existence. The statue symbolizes the need to find meaning in life and achieve self-actualization.
Effect on shading	**Franz Kafka's Head statue has a significant impact on shadows in several ways.** • First, the statue casts large and varied shadows on the ground. These shadows can be interesting and enjoyable to look at. • Second, the statue can help create a dark and mysterious atmosphere. This atmosphere can be appropriate for certain events, such as parties or plays. • Third, the statue can help protect people from direct sunlight. The shadows cast by the statue can be a comfortable place to relax on a sunny day. • The shadows cast by the statue can be used to create a path or trail. This can be helpful in guiding people in a dark or unfamiliar area. • The shadows cast by the statue can be used to create games or optical illusions. This can be fun for children or people looking for some fun. • The shadows cast by the statue can be used to create a private or intimate space. This can be beneficial for people who want to relax or think in peace.
The effect of Franz Kafka's Head statue on natural lighting	• The statue can block direct sunlight. This can reduce the amount of natural light in the area surrounding the statue, making it cooler and more comfortable. For example, the statue can block direct sunlight from a seating area or a playground, making it a more suitable place to relax or play. • The statue can diffuse sunlight. This can create interesting light effects, such as light and shadow games. For example, the statue can diffuse sunlight in a garden area, creating a fun pattern of light and shadow. • The statue can reflect sunlight. This can increase the amount of natural light in the area surrounding the statue, making it brighter and warmer. For example, the statue can reflect sunlight in the entrance area of a building, making it a more welcoming and inviting place. (https://en.wikipedia.org/wiki/Head_of_Franz_Kafka)

Table 6. Analytical study of the Prophet's Mosque umbrellas

.

Analytical study of the Prophet's Mosque umbrellas	
General description of the Prophet's Mosque umbrellas	• Location: The Prophet's Mosque, Medina, Saudi Arabia. • Idea: The idea was ordered by King Abdullah bin Abdulaziz, who ordered the construction of umbrellas for the courtyards of the Prophet's Mosque, which was supervised by the General Presidency for the Affairs of the Grand Mosque and the Prophet's Mosque. • Completion: The project was completed in August 2010. [18]
Architectural description of the Prophet's Mosque umbrellas	• Initially, the project included the construction of 182 umbrellas on the columns of the mosque courtyards, then 68 umbrellas were added in the eastern courtyards, bringing the total number of umbrellas to 250. • Each umbrella shades an area of about 57 square meters. • The total area of the shaded areas is about 104,000 square meters, which can accommodate about 29,000 prayer mats. • The umbrellas are a major addition to the Prophet's Mosque. They provide much-needed shade and protection for pilgrims and visitors, and they have helped to create a more welcoming and comfortable environment for worship and prayer.  . **Fig.22**.The General Location of the Umbrellas of the Internal and External Squares of the Mosque and the Mechanism of Opening and Closing • The height of the umbrella fabric tip when open is approximately 0.15 m, and when closed is approximately 21.3 m. • Open umbrellas prevent sunlight from reaching the square during the day, while closed umbrellas allow hot air to rise up at night. • The semi-transparent cover of the umbrellas blocks sunlight.
Structure of the Umbrellas of the Prophet's Mosque	**The steel frame of a single umbrella is composed of the following parts:** • Upper cylinder: This cylinder contains the telescope and the operating unit • Eight upper supports: These supports provide structural support for the top of the umbrella. • Eight inner arms: These arms support the canopy and provide structural support for the umbrella. • Eight lower supports: These supports provide structural support for the bottom of the umbrella. • Four diagonal arms: These arms provide structural support for the umbrella and help to prevent it from swaying in the wind. • Eight supporting arms for the diagonal arms: These arms provide additional support for the diagonal arms • Four middle arms: These arms help to support the canopy and provide structural support for the umbrella.

<table>
<tr><th colspan="2">Analytical study of the Prophet's Mosque umbrellas</th></tr>
<tr><td>Structure of the Umbrellas of the Prophet's Mosque</td><td>

Eight supporting arms for the middle arms: These arms provide additional support for the middle arms.
Crown and spear: These parts form the top of the umbrella.
The umbrella structure consists of a metal mast mounted on a concrete column covered with white marble.
The mast supports a mechanical frame that is moved by a hydraulic cylinder that works with oil that is pumped into it to move the arm that opens and closes the umbrella.
This process is controlled by the main computer of the building, which is connected to each umbrella through underground channels, so that the status of the umbrella appears on the control panel if it is open, closed, or disabled.
The opening and closing process was carried out in complete silence without any noise despite the large size of the umbrellas.
The umbrellas are mounted on lighting poles, which consist of a high-strength steel pipe with a height of 50.6 m mounted on square concrete bases with a side length of 10 m, and a depth of 0.6 m in the ground.
The umbrella unit brings together the structural structure, lighting, air conditioning, sound, and hydraulic opening and closing systems.
Air conditioning outlets were placed in the bases and crowns of the columns that support the umbrellas. Rainwater also collects and drains in the center of the umbrella, where it flows into the central funnel consisting of a copper ring.

</td></tr>
<tr><td>Improved efficiency of the Prophet's Mosque using umbrellas</td><td>

Provide shade: The umbrellas provide shade for worshipers and visitors in the Prophet's Mosque, protecting them from the scorching sun in the summer and from rain in the winter.
Improve ventilation: The umbrellas work to improve ventilation in the Prophet's Mosque, helping to cool the temperature and prevent the spread of foul odors.
Air outlets located at the base and center of the umbrella column distribute cold air without noise over a wide area.
The entire quadrant is cooled evenly and effectively.
A total of 436 misting fans were installed in the umbrella columns, distributed over the mosque's courtyards.
The fan aims to humidify the outside air in the courtyards of the Prophet's Mosque under the umbrellas by absorbing heat energy in the air.
Improve aesthetic appearance: The umbrellas contribute to improving the aesthetic appearance of the Prophet's Mosque, adding a touch of beauty to the place.
the umbrellas help to reduce energy consumption, as they are powered by solar energy. They also help to protect the environment, as they are made of environmentally friendly materials.


Fig.23. The Prophet's Mosque Square Umbrellas
http://alfozanaward.org
</td></tr>
</table>

The research findings suggest that a proposed strategy for improving the efficiency of architectural and urban spaces can be achieved by applying the design requirements guide for improving the efficiency of spaces, extracting criteria for improving the efficiency of spaces from the theoretical and analytical study in dynamic architecture, identifying the factors that support efficiency at the level of space and general location, identifying the characteristics and strategies of dynamic design, and identifying the mechanisms for implementing the efficiency improvement strategy using dynamic composition.

Table 7. Proposed Strategy for Studying the Impact of Using Dynamic Composition to Improve the Efficiency of Architectural and Urban Spaces

<table>
<tr><th colspan="3">Strategy for Studying the Impact of Using Dynamic Composition to Improve the Efficiency of Architectural and Urban Spaces.</th></tr>
<tr><td>Types of Efficiency
Economic efficiency (construction cost)
Social efficiency (interaction of space users with each other and with the architectural element)
Aesthetic efficiency (integration of the external formation with the environment)
Environmental efficiency (location and indoor environment)
Functional efficiency
Cultural efficiency
Architectural efficiency</td><td>Criteria for improving the efficiency of architectural and urban spaces
Quality of life
Comfort for users
Sustainability
Lightweight construction
Climate change adaptation
Internal and external environmental quality
Dynamic design
Renewable energy
Energy efficiency
Recycling
Efficiency rating and assessment system
Achieving the social needs of space users, including:
Good arrangement of furniture.
Comfort of use.</td><td>Factors supporting efficiency at the general site level
Clarity of the site
Visibility
Accessibility
Relationship to major movement axes
Openness to surrounding urban spaces
User control of movement
Dynamic design strategies</td></tr>
</table>

<table>
<tr>
<td>Elements of Efficiency

• Building envelope
• Façade
• Windows
• Interior walls
• Ceilings
• Building equipment

The Benefits of Efficiency Elements

• Movement, whether complete or partial.
• Flexibility and efficiency.
• Using materials that change shape and color with changes in stress and surrounding conditions.
• Using a smart envelope.</td>
<td>o Achieving privacy.
o Integrating areas that depend on each other to conduct activity.
• Achieving the needs of vacuum users with the lowest financial value, including:
o Determine spaces.
o Connecting and assembling the spaces that depend on each other to carry out the activity.
o Achieving alignment and flexibility with individuals' needs.
o Acceptable material cost
• Achieving design goals to achieve users' desires, including:
o Lighting.
o Good ventilation.
o Maintainingthe appropriate temperature.
o Providing security, safety and audio comfort for users
o Increase the use of internal space.</td>
<td>• Convertibility
• Change of size
• Change of place
• Modification.
• Multi-use
• Flexibility
• Response to climate change.
• Change building components.</td>
</tr>
<tr>
<td colspan="3">Strategy for Studying the Impact of Using Dynamic Composition to Improve the Efficiency of Architectural and Urban Spaces.</td>
</tr>
<tr>
<td colspan="2">Factors supporting efficiency at the space level

• The space must be prepared for people's use
• Providing aesthetic properties.
• Taking into account diversity.
• Taking into account the technical aspects in studying the elements of space.
• Launching creative initiatives in engineering design for its various details.
• Supporting the role of space as an attractive element
• Providing comfort conditions.
• The site contains elements of appropriate urban furnishings, elements of site coordination with appropriate standards that allow people to interact with them in addition to various means of entertainment and services.
• Providing appropriate spaces designated for holding various events and activities for different ages and people with special needs.
• Achieving the best conditions for engagement and interaction with the environment.
• Achieving the conditions of vitality, sensation and suitability required in the built environment.
• Providing all environmental requirements that provide protection from negative weather factors.
• Protection from pollution in its various forms.</td>
<td>Dynamic design characteristics

• Ability to control solar radiation.
• Achieving adequate lighting.
• Achieving architectural quality.
• Ability to improve the quality of the internal and external environment.
• Responding to climate change.
• Ability to change shape.
• Reducing construction time by using prefabricated parts.
• Controlling the amount of energy exchanged between the interior and exterior.
• Using environmentally friendly materials that can be recycled.
• Using dynamic motion to generate wind.
• Ability to control the texture of the building's exterior envelope.
• Ability to add and subtract parts of the design.
• Ability to control the shape of the motion.</td>
</tr>
</table>

• Ensuring the economic efficiency of the various elements and components of the space. • Material selection. • Selection of executive processors. • Easy maintenance. • Taking into account diversity and consistency. • Maintaining harmony. • Achieving the best conditions of convenience and comfort for users. • Study the elements and details of space from horizontal surfaces. • Study the elements of site coordination and furniture • Urban and all urban and architectural details. • Providing a sense of security and safety. • Achieving effective and passive connection to the vacuum. • Meeting the needs of various segments of society.	• Ability of dynamic spaces to meet the needs of users. • Using dynamic form to save energy. • Interacting with the surrounding environment culturally and socially. • The building's ability to be energy self-sufficient.

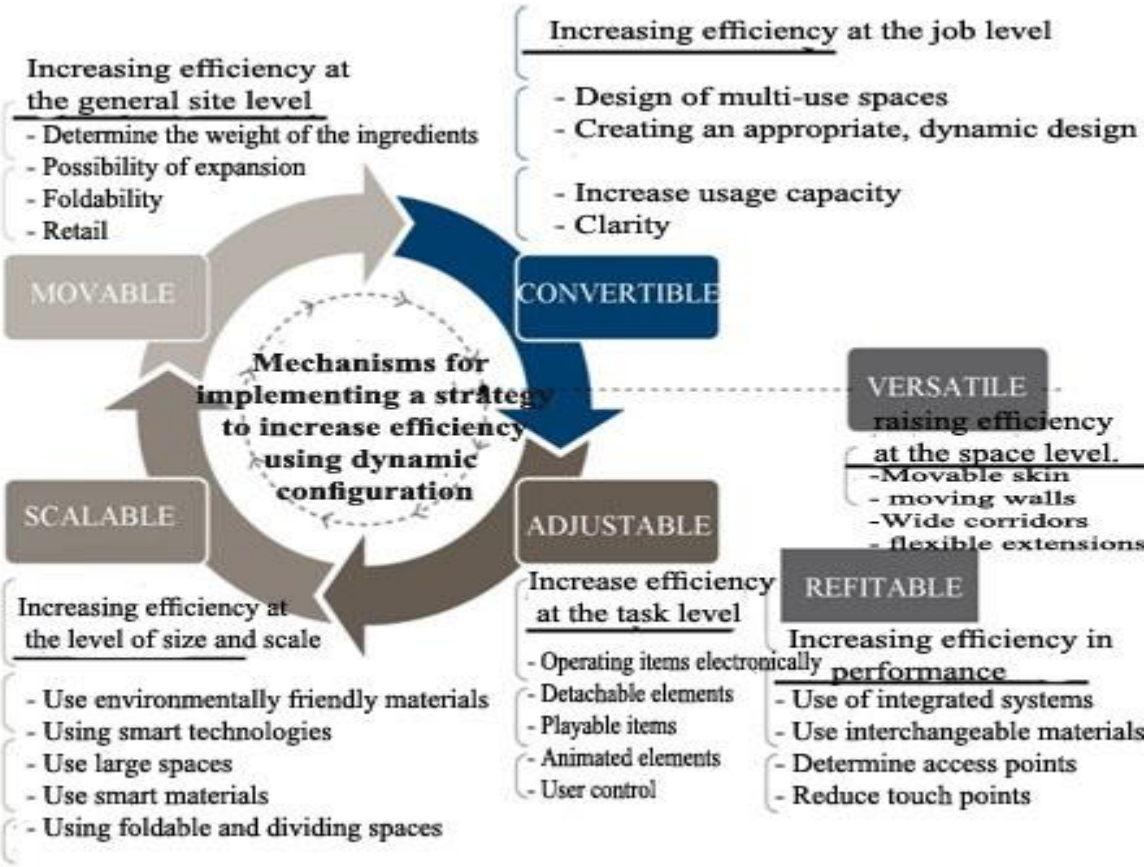


Fig.24. Mechanisms for implementing a strategy to increase efficiency using dynamic configuration

Conclusions

The research has succeeded in reaching a set of results, the most important of which is that the use of dynamic configuration works to raise the efficiency of architectural and urban spaces, and to confront climate changes by achieving comfort for the users of the space, in a way

that meets human needs. The importance of using the dynamic configuration is to meet changing human needs according to different environmental changes.

The use of the dynamic configuration in design is considered a flexible process that is compatible with different climatic conditions (sun - heat - wind - rain) in order to achieve thermal and acoustic comfort and indoor air quality. The use of dynamic configuration, whether in buildings or outdoor courtyards, greatly reduces energy consumption through adaptation, as energy can also be collected to reach architectural and urban spaces that do not consume energy. New design standards can be deduced through the relationship between dynamic architecture and changing human needs to evaluate the use of dynamic configuration and determine the extent to which human needs are achieved. There is a direct relationship between the number of criteria achieved and the success rate in meeting this need. A proposed strategy has been developed to raise the efficiency of architectural and urban spaces, and to determine the mechanisms for implementing the research strategy by raising efficiency at the level of (space, function, location, performance, task, size and scale) and thus The results support the validity of the study's hypothesis, determine the impact of the change in space on the occupants, and use the outcomes of dynamic architecture to increase the efficiency of spaces for building users and occupants of external courtyards. The proposed strategy for improving the efficiency of architectural and urban spaces using dynamic composition is a promising strategy, as it can contribute to achieving higher efficiency for architectural and urban spaces, through achieving flexibility and adaptability in the design, and interacting with the surrounding environment.

References

[1] Sati' A, S, 2012, Urban Growth Dynamics in Iraq, Journal of Planning and Development, University of Baghdad, No. 241, p. 26.

[2] Al-Badawi,S, Y 2015, Drawing inspiration from movement in the growth forces of natural formation as a principle for a growing spatial architecture, International Design Journal, Volume (5), Issue (4), p. 1656.

[3] Hassan, Safaa, 2014, Kinetic Technology between Art and Architecture, Master's Thesis, Faculty of Engineering, Cairo University.

[4] Suwaidan,M, 2014, Energy Saving in Dynamic Architecture as a Means of Developing a Specific Practical Guide to Design Standards for Dynamic Buildings, Master's thesis, Faculty of Engineering, Cairo University.

[5] Hassouna,A, Toaima, Zahran, 2022, Benefiting from the philosophy of dynamic architecture in fashion design, Journal of Applied Arts and Sciences, Volume Nine, Issue Two, April.

[6] Yolanda Harris Riversdale: (2000) AD ‹"From Moving the Image to Moving Architecture- A discussion of the "Space- Time" phenomenon of the twentieth century, with particular reference to architecture, moving image, and music. "Grant Chester Cambridge England, Pp.2

[7] Hisham S, 2010, "Architecture and Urbanism of the Third Millennium, from the Implications of Imagination, Book One, Imagination is the Absent Queen, published by the Center for Planning and Architectural Studies, Cairo, Egypt.

[8] Al-Nahhas.M, Ahmed, Iman, The impact of automation of dynamic architecture of external envelopes on energy consumption, Engineering Research Journal (ERJ), Vol. 51, Issue 2, January 2022, Pages 102-2

[9] Makki.A, 2017, Mechanisms for Applying Smart Architecture Requirements to Administrative Buildings, Master's Thesis, College of Engineering, Islamic University, Gaza..

[10] El Attar, S. (2013).Smart structures and material technologies in engineering applications Academic Journals, 8(31), 1512-1521.

[11] Michelle Addington and Daniel l. Schodek (2005), "Smart Material and New Technologies for architecture and design professions", Harvard University, Architectural Press.

[12] Al-Badri.A, Abdel-Razzaq.H, The Concept of Technical Systems for the Thought of Smart Building Architecture, University of Baghdad, Iraq, Engineering Journal, 2008

[13] El Shimmy, Mahmud, "State of the Art Research",Department of Architecture, Faculty of Engineering, Cario Universitym not published, 2000.

[14] Mohamed.H, The role of smart technology in raising the performance efficiency of interior spaces in buildings, a case study of the architectural design studio space, the Eighth International Scientific Conference, Faculty of Engineering, Cairo University, 2019..

[15] Saad.K, 2019, Dynamic interfaces as an approach to improving levels of environmental performance within the educational space using digital design tools, Master's thesis, Faculty of Engineering, Fayoum University.

[16] Panda A.K., Mishra B.G., Mishra D.K., Singh R.K., 2010. Effect of sulphuric acid treatment on the physico-chemical characteristics of kaolin clay. Colloids Surf A Physicochem Eng Asp 363(1-3): 98–104.

[17] Ethan, & Abd ulmajid. (2015, 3). innovations in dynamic architecture The AL-Bahr Towers Design and delivery of complex facades. 178. paper ,journal of Façade Design and Engineering.

[18] Abdo.M, An analytical study of the moving architectural elements in the interior architecture space of the Prophet's Mosque, Journal of Architecture and Human Arts, Volume Five, Issue Twenty-Two, 2019.

Websites

https://www.sageglass.com/

https://ar.wikipedia.org /

https://www.sciencedirect.com/

architecturaldesignschool.com

fosterandpartners.com(

http://alfozanaward.org

https://en.wikipedia.org/wiki/Head_of_Franz_Kafka