

# Using Modern Techniques in the Formation of Flexible Interior Spaces: Insights from Iraq

Doaa Hazim Aziz & Rand H.M. Agha

Department of Architecture Engineering, College of Engineering,  
University of Baghdad, Iraq.

Emails: [Doaa.Aziz1504M@coeng.uobaghdad.edu.iq](mailto:Doaa.Aziz1504M@coeng.uobaghdad.edu.iq)

[Rand.h.m.gha@coeng.uobaghdad.edu.iq](mailto:Rand.h.m.gha@coeng.uobaghdad.edu.iq)

Received	Reviewed	Revised	Published
12.10.2023	21.10.2023	25.10.2023	31.10.2023

<https://doi.org/10.61275/ISVSej-2023-10-10-15>

## Abstract

The research is based on the assumption that there is an effective relationship between techniques and the flexibility of interior spaces, and that this relationship has a great impact on the formation of contemporary interior space. Hence, the research aims to reveal the effect of using modern techniques in the formation of flexible interior spaces.

To achieve the goal, the deductive approach is employed. It consists of a survey of literature related to interior spaces, flexibility, and techniques; and a case study of a chosen space at the Department of Architecture Engineering at the University of Baghdad. The qualitative methods employed 16 indicators and 2 design models of the studio space. A Google form comprised of a checklist was used to collect the data analyzed using statistical analysis software (T-test). The respondents were 16 staff, 13 students and faculty.

The findings show 3 strong indicators and 9 effective indicators in the comprehensive and partial analysis of (the T-test). It is concluded that there is a strong effect of the three indicators. It is also concluded that flexibility of the interior spaces is achieved by using some techniques by applying them to the interior elements of the studio space, such as partitions and furniture.

**Keywords:** Flexibility, Techniques, Interior space.

## Introduction

By assuming that there is an effective relationship between technologies and internal space flexibility, and that relationship has a significant impact on the formation of the internal space's final shape, the research aims to reveal the impact of the use of modern techniques in the formation of flexible internal spaces. Since there are numerous studies that have raised this issue from a technological standpoint, the current research focuses on interior space techniques rather than information and computer techniques. To determine the extent of the impact of techniques on interior spaces, the research relies on the study of educational spaces in particular, rather than interior spaces in general, as well as contemporary interior spaces only, represented by the period limited to the last four decades, and includes the study of the impact of techniques on the flexibility of a formation of contemporary interior spaces in particular. The significance of the research is to provide a foundation of knowledge for the architect to comprehend the new possibilities of flexibility in the formation of interior spaces to invest them in the design process.

A positive environment that serves as a backdrop to interior forms whose nature may be recognized and comprehended through size and shape is what can be referred to as an internal space. Space gains its worth from the existence of factors that set it apart from its surroundings, which makes it even more important to be created in a way that maximizes human desires and meets the needs and objectives of the people (Agha, 2001). The ability of the system to react to potential internal or external changes that affect how well its value is delivered is how the ambiguous term "flexibility" is defined. While Al-Numan (2003) defined flexibility as utilizing the complete chronological life of the building by adapting and redesigning it to conform with ongoing changes, Gjakun (2015) defines flexibility as doing so appropriately and economically. He emphasizes that when deciding whether a structure has to be modified or expanded to accommodate modern activities, economic reasons frequently play a crucial role. According to Gjakun (2015), flexibility is the ability to adapt an interior space and all of its components as quickly and effectively as possible to new developments. This can be done by changing shape, area, color, materials, furniture, structure, and other elements of the space on different individual levels, or by implementing smart technologies to bring about the desired change. In other words, it is a multi-purpose room that may be used for several purposes to create an adaptive space tailored to the user's changing needs rather than one that is continuous and exists forever. According to Deniz and Ouz (2020), techniques are defined as a comprehensive transformation of human, operational, and technological factors carried out by organizations to ensure more effective, efficient services and user satisfaction. These opportunities are provided by rapidly evolving information and communication technologies as well as changing social needs.

## **Theoretical Framework**

### **Flexibility in the interior spaces**

One of the most significant ideas that has a favorable impact on interior design of space is the idea of flexibility. It is capable of absorbing the quick technological and societal changes. The idea of flexibility has a direct impact in the field of interior space design because it aims to address the gaps in the social needs of individuals while also providing all aesthetic and functional considerations that require the plan be developed jointly by the interior designer and the design engineer in order to address all future requirements (Salah, 2019). Flexible designs contain certain deliberate decisions to boost the ability of buildings to absorb change. Similarly, flexible design research aims to find the architectural qualities that increase a building's ability to absorb change. As a result, design choices are made that facilitate both accommodating change without adapting as well as facilitating adaptation to change (Al-Nujaidi, 1985). Proposals for flexible designs vary from one another in terms of the following.

- Change: Several flexible design concepts are focused on making it simpler to account for comparatively minor changes in requirements.
- Adaptation: While in some cases, the emphasis has been on assimilating change without adaptation, in others, the focus has been on adapting to change.

One of the most crucial suggestions for a sustainable environment is flexibility, which emphasizes the necessity to develop structures that combine performance and survival qualities to minimize environmental waste (Salah, 2019). In addition to the efficiency of the size of the space and the adoption of flexibility in the floors and levels of movement and expansion recoverable, the principles of flexibility and shape characteristics are used in the design of furniture and the structure of space to achieve efficiency in the exploitation of horizontal space (Oday et al. 2014). Therefore, it is crucial to understand the idea and philosophy behind flexibility in order to establish its significance in the field of interior design. One of the key influencing points to face future developments and to lay the groundwork for fulfilling all functional and aesthetic requirements is through the possibility of change, modification, addition, deletion, and others using all available means, whether traditional, technological, or

virtual. As a result of rapid technological advancement or numerous social changes, this helps to adapt internal reality to changing human needs.

It is also obvious that recognizing change through time, whether it be functional or intellectual, causes a designer to consider the value of flexibility in a number of areas, such as the following.

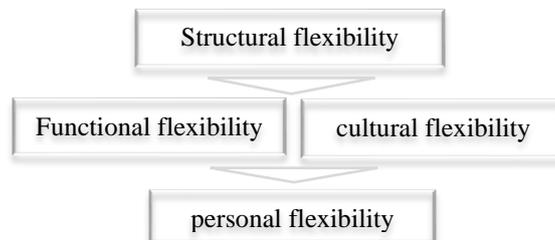
- The economic component permits utilization throughout the building's lifespan.
- Functional compatibility between a person and a structure can continue because to this element.

In terms of the social component, it enables a user to communicate his identity and intellectual state at a particular moment and within the confines of the building's architecture (Forsyth, 1982). Flexibility also strives to retain the value of quality at the highest level throughout the life of the space (Senem and Arda, 2016). Indeed, this is done by quickly adapting the largest amount of space and all of its components to changes and advancements. Since adapting to change can be done with or without using building conditioning, flexibility goals are concerned with doing so. From an architectural perspective, the significance of flexibility is to provide the capability of changing the fixed environment to meet functional, technological, and human changes in order to continue to be able to meet the primary user needs (James Douglas, 2006). In terms of flexibility from an economic perspective, this entails making the most of the building's lifespan by modifying and redesigning it to accommodate ongoing changes.

Dinber (2010) reaffirms that economic considerations frequently play a significant part in evaluating if it is required to adapt or extend any building and house modern activities. In fact, how much change and adaptation are required can be used to measure how flexible a person is. More flexibility has frequently been associated with both a narrowing resource requirement of the methods and a broadening of the scope of the aims. Moreover, Ibtisaam & Raz (2019) propose a number of techniques for evaluating flexibility as follows.

- Diversity (many different roles),
- Mobility, capacity to partition interactive environment, the capacity to change, responsiveness, balance, and adaptability

According to Hovland (2005), flexibility is categorized as seen in the Fig. (1-1) as follows,



**Fig 1:** some furniture techniques in space  
Source: Author

High usability is achieved by means of spatial flexibility in university buildings by incorporating a set of design elements that help the spaces adapt to changes in the various functional and usability requirements (Shaba, 1986). This illustrates the significance of flexibility in interior spaces of universities. The forces of change that have an impact on the university system, according to Al-Noman (2003), are the following.

- Population growth that necessitates an increase in usage
- social effects of educational policies.
- As a result of advancements in social and cultural life, the educational system must function better.

What is highlighted above, the importance of flexibility in the design of interior spaces and its significant role in containing rapid changes and expansion by adjusting the conditions of the

interior walls to achieve the requirements of living are keeping pace with the times. The goals of flexibility are clear in maximum adaptation to the changes occurring within the space to meet the requirements.

### **Techniques of Interior Spaces**

These highlight the importance of flexibility in the design of interior spaces and its significant role in containing rapid changes and expansion by adjusting the conditions of the interior walls to achieve the requirements of living and keeping pace with the times.

The goals of flexibility are clear in maximum adaptation to the changes occurring within the space to meet the requirements. They are as follows.

- Control heating systems, as well as façade and window systems, using clever methods that take into account the amount of light in the area (Agha,2022).
- Smart technologies allow for the control of energy, heating, ventilation, household service equipment, and related systems and furnishings, as well as social, environmental, and economic comfort.
- Gathering data on the environment. With the aid of smart technologies, many areas need environmental data to be formed. A key factor in influencing the choices made by smart technologies is the collection of data on the ambient conditions of the internal and external spaces (Agha, 2016).
- Ascertain the building's condition. allowing for in-depth understanding of the state of the area through the use of weather data from the present and the future to determine the ideal value in the area, as well as preheating the area and setting up levels of lighting and shading.
- The degree of performance by managing disaster and escape protection systems, tracking thieves, and protection and alerting systems for a safe living (Deniz, 2020).

The use of contemporary design techniques depends on the relationship between furniture and space. For example, a bed can be concealed within a wall, floor, or ceiling to become a part of the design, or it can be raised to the ceiling. Furniture can also have certain shape characteristics that add a function change gained from repeating the piece of furniture with a different arrangement or by adding other pieces without reducing the aesthetic and functional efficiency of the space in a room. Utilizing the same piece of furniture for several purposes, for instance, preserves internal spaces and increases our ability to scale.

These notions, which are best exemplified by the capacity, diversity, balance, and fitness requirements, are used in the design of spaces. The ability to live in a space depends on the effectiveness of a smaller space, as well as the design approach based on sustainability criteria to provide economically efficient spaces and aesthetics. Moreover, livability of a space depends on the availability of adequate services, energy, and space for each individual in addition to the economic factors (Oday et al. 2014).

Types of technologies in interior spaces:

#### **Vertical Surface Techniques (walls, partitions)**

The importance of vertical surface technologies becomes clear when providing flexibility to a space and thus comfort to the users due to it providing several spaces with different functions for the same space. This is done by removing and adding partitions, or moving walls, in addition to smart walls that are characterized by the presence of high-tech screens that change according to the user's request (Clark,2021).

#### **Horizontal surface techniques (floors, ceilings)**

According to Paddeu (2008) horizontal surface technologies, such as folding ceilings,

storage, and sliding floors, provide the users with new space functions and optimal use of spaces, thus saving costs and achieving space efficiency.

### **Shape and shaping techniques**

According to Weck (2008), shape and shaping techniques achieve different configurations by reshaping spaces such as walls and ceilings at different times. This achieves the ability to create multi-functional spaces to meet different requirements and improve the capacity and development of a space.

### **Furniture techniques**

Jose (2016) points out that furniture that uses information about the surrounding environment provide functionality and comfort to its users. For example, furniture that provides integrated functionality or furniture that has at least a complete second purpose do so. It may be defined in other words as furniture that integrates the latest IT technologies to provide remote access. As Jose (2016) says they provide added value, functionality, comfort and elegance to suit all personal requirements of the user.

### **Color and light techniques**

The importance of using color and lighting techniques in improving interior spaces becomes clear by monitoring and controlling spaces to provide comfort for users as well as achieving security and safety by providing an automation and control system, for example using a smart light that dims when the user is not close to it or becomes brighter and more targeted when the user is studying. This is to get a better living experience (Niva,2020).

### **Structure and mass techniques**

Smart interior design solutions should include flexible structures that can accommodate smart design elements. In particular, solutions must maintain a responsive cabling design, open space with movable or demountable partitions, raised floors, suspended ceilings, and mechanical floors to allow communication between different design elements via a single infrastructure (Ibtisam&Raz,2019).

### **Material and texture techniques**

The importance of materials and texture techniques through the use of smart materials in the design of spaces to provide appropriate solutions using materials with variable properties, resistance, or nanomaterials, and then achieve a building state that is more aesthetic and appropriate to the conditions.

### **Transition techniques (horizontal and vertical)**

The modular design of these stairs allows for construction that meets your individual needs. It installs or disassembles quickly, so it can easily be taken upstairs if you move into a space. Each step is locked into a side plate at both ends, and rotates 90 degrees around the integral rotation axes. With just one smooth motion, the stairs open from the wall or fold back again (Niva,2020) Fig. 2 & 3.

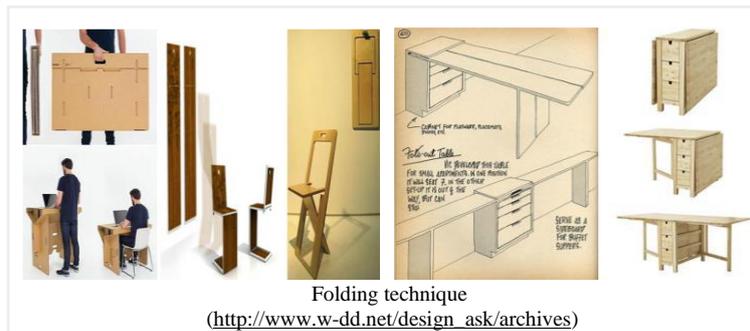


The figure shows furniture techniques

<https://www.dezeen.com/2014/05/03/reconfigurable-melbourne-studio-particular-architects/>



**Fig. 2:** some furniture techniques in space



**Fig.3:** Some furniture techniques in educational spaces

Any formation indicates a way of creation, and form formation represents a natural outcome of the types of technologies used. All types of interactions, including proportionality, scale, organization, and spatial distribution, are the result of technology (Al-Mudarris, 2003). Frampton also discussed the current theory of production, citing Norman Foster's work, which emphasizes how technology shapes form and emphasizes how architectural form is closely related to product specifications and function.

From the foregoing, the importance of smart techniques to achieve the flexible design of contemporary interior spaces becomes clear. It involves presenting contemporary alternative solutions to obtain spaces with multiple functions that fulfill the user's needs and have a lower cost relative to traditional design, by using some tools such as moving walls, furniture, and partitions, as well as using lighting, colors, and materials.

### **Review of Literature**

Much previous literature has been interested in studying flexibility in interior spaces using techniques. According to Arslan (2022), the study mainly aimed to present the changing design principles for contemporary interior spaces that have developed in recent years differently from the past, and focused on the methods of producing contemporary style spaces, which are fundamentally different from traditional spaces, especially through the themes of flexibility, dynamism, and diversity in composition. Contemporary spatial relations as a conceptual tool. The study clarified the principles of flexible design for contemporary interior spaces in general by clarifying contemporary alternatives for achieving spaces with multiple functions using some tools such as moving walls, furniture, and partitions, as well as using lighting, colors, and materials. The study did not mention flexible educational spaces.

While Hala (2019) explained the goal of the research to achieve what is called flexibility in designing spaces to achieve the most important requirements and evolving variables and keep pace with the current era, the problem of the research was to prove the importance of the concept of flexibility because of its major role in containing rapid changes in technological means as well as social requirements. The research discussed the importance of flexibility in the design of interior spaces in general and its major role in containing rapid changes and expansion by modifying the conditions of interior walls to achieve the requirements of living and keeping up with the times. It did not address achieving flexibility in shaping educational spaces.

Gjakun's (2015) study reveals trends for future developments of flexibility and comfort conditions in interior spaces in residences, and will be useful in identifying the appropriate target market for this type of living options in the future. The study addressed aspects of flexibility of configuration, such as moving and sliding walls and furniture in interior spaces to achieve comfort for users in residences (residential units), and not on flexibility of configuration of educational spaces.

Al-Numan (2003) described one of the important architectural phenomena, which is the phenomenon of functional and spatial change over time, which characterizes university buildings because the university system is vulnerable to modification due to the continuous change in social, technological and other requirements. The study converges with current research in addressing the design characteristics of the flexibility of the interior spaces of educational buildings and their impact on movement in those spaces. The research did not address the flexibility of configuration for that type of space.

As for Al-Najidi's (1985) study of the relationship between the design of interior spaces and flexibility and proposing a measurement system through which the extent of integration of design variables into the established design proposals can be determined, as well as proposing measurement system through which the extent of flexibility of the buildings used can be evaluated, as well as evaluating the extent of flexibility achieved by integrating design variables into the design proposals through a study. Actual buildings in use via designers' proposals on how to incorporate the ability of spaces to accommodate changes in requirements of the activities to be housed in the buildings over time into a variety of ideas regarding the relationship between proposed design variables and achieved flexibility. The study addressed the relationship between the design of interior spaces by evaluating the extent of flexibility of the buildings used, as well as evaluating the extent of flexibility achieved by integrating design variables. The study also showed that the flexibility of the spaces used can be predicted to a

large extent through knowledge of their design, and the research did not address the flexibility of space formation. Educational

The Baper & Saied 2020 study explored the impact of the use of smart materials on the construction and design process and analyzed the movement structure, design areas and components of interior architecture for multi-functional use with smart solutions for the purpose of exploring the best approach to make interior architecture with flexible qualities. The research discussed the impact of the use of smart materials on the design process. For interior spaces, it also identified the positive relationship between the factors of smart design solutions and their impact on the flexibility of small spaces for residential apartments in general, and did not address the flexibility of configuration for educational interior spaces in particular.

While the research of Ibtisam & Raz (2019) concentrated on the topic of the positive impact of using smart technology promotes comprehensive building flexibility and sustainability, the study of Jose et al. (2015) demonstrate smart interior design solutions, such as efficient and adaptable furniture, movable walls, and other space-saving techniques, and their relationship to the efficient use of spaces. Their main objective was to determine how flexible furniture and flexible structures, such as those utilized in flexible structures can achieve spatial flexibility in interior spaces in homes. Amerigo's (2005) highlights how new information technologies have an impact on interior space design through new activity patterns for interior spaces that are intuitively understandable and evaluable. According Salahaddin & Aisha (2020), however, it is determined that there is a positive correlation between the elements of smart design solutions for small spaces, such as apartments, as well as the impact of the use of smart materials on the design process of interior spaces.

A study by Leonardo Amerigo (2005) explained how distributed intelligence can increase productivity and enrich the experience of indoor spaces. Ubiquitous computing is transforming spaces by allowing facilities, goods, and information to be delivered where and when we need them. Smart interiors can be more flexible and expressive than traditional spaces. The study discussed how new information technologies affect the design of interior spaces through new patterns of activities for interior spaces, which can be understood and evaluated intuitively, as well as being more flexible and functional to enrich daily activity with experiences. The study did not address the flexibility of configuration of interior spaces.

These highlight the main areas that literature for space-related elements concentrate on. Previous research has concentrated on analyzing the effects of smart design on obtaining spatial flexibility of interior spaces, particularly in houses. In this context, this research seeks to disclose the influence of the use of methods in the flexibility of a formation of internal spaces to achieve the convenience of users. Most research have not addressed the impact of using techniques in the formation of flexibility of educational interior spaces.

## Research Methodology

The following approach of deductive and qualitative method is used: Creating a theoretical framework that would support methodologies and the notions of flexibility in modern interior design.

- Extracting clues about the connections between techniques that enable the flexible space of modern interior environments.
- Creating a model and using the indications that were extracted to it. Data collection process consists of the theoretical aspect, extracting indicators from a review of previous literature, the practical aspect, and designing the model as follows:

The theoretical aspect and indicators extracted from the previous literature review Indicators can be extracted from the theoretical framework for each of the basic search terms, i.e. interior spaces, flexibility and technologies, and then the indicators for interior space, flexibility and techniques are selected and then built, obtaining the vocabulary that will be applied to the chosen space and testing it (Table 1).

**Table 1:** Flexibility of forming contemporary interior spaces for architectural studio  
Source: Author

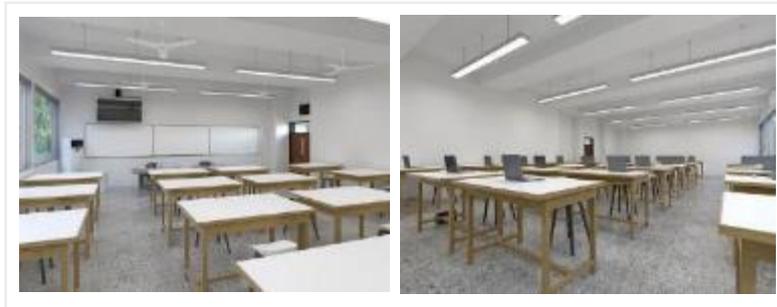
n	Relationship indicator	The secondary indicator of the relationship and its possible values	s
1	Space redistribution	The geometry of the space can be altered by deleting and removing the vertical elements that the partitions represent using the hinge folding technique.	<b>X1</b>
		A change in the geometry of the space is achieved by deleting and removing the vertical elements represented by the partitions using the hinge folding approach	<b>X2</b>
		The studio space is divided and condensed utilizing the hinge folding technology, which reshapes the area.	<b>X3</b>
		A change in the size of the room is achieved by adding and enlarging the studio space through walls utilizing the technique of separation and merging through recombination.	<b>X4</b>
2	control	Employing the responsive walls technique to alter and adjust the vertical elements represented by the studio space's partitions in order to vary the shape.	<b>X5</b>
		Employing sensors to achieve alternative solutions, updating and developing the vertical aspects indicated by the studio space's partitions.	<b>X6</b>
3	Using the interior spaces	Alternate solutions are achieved by rearranging and reconfiguring furniture for the studio area utilizing the folding technique, as in the professors' table.	<b>X7</b>
		Utilizing the sliding horizontal rail technology, space can be added to and expanded through partitions.	<b>X8</b>
		The technique of sliding furniture with horizontal rails, as in the overlapping of the teaching table, to lower its size and maximize space can be used to add and expand the space	<b>X9</b>
		A change in the use of the space is achieved by dividing and constricting it utilizing vertical features, such as partitions, and the sliding horizontal rail approach.	<b>X10</b>
		Student chairs are an example of recombination in the variety and multiplicity of furniture used in a location to fulfill user's needs.	<b>X11</b>
		Utilizing the separation and merging process, furnishings of the studio will be changed and replaced.	<b>X12</b>
		Using the separation and merging approach, replacing and modifying the furniture of the studio	<b>X13</b>
4	Responding to user requirements	Using the hinge folding method to change and adapt furniture for space, like in the professors' table.	<b>X14</b>
		The capacity to vary the shape of the furniture is achieved by using a variety and abundance of furniture for the space and a vertical rail sliding approach similar to that used in student board.	<b>X15</b>
5	reconfiguration	In order to maximize space, remodeling and developing space furniture employing strategies similar to those used in student boards.	<b>X16</b>

### Case Study

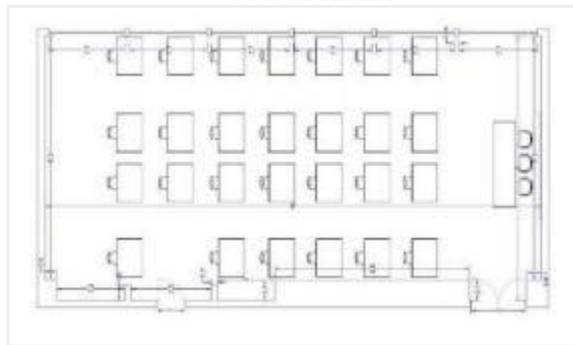
College of Engineering building of the University of Baghdad's, specifically the space of the Department of Architecture's studio (has a dimension of 9 by 18 meters), was chosen for the case study. The studio is subject to change in function depending on the methods that can be used to obtain alternative solutions for the same area, and it is educational, especially ceremonial.

To conduct the practical research study, appropriate tools are selected for practical application, such as indicators and model building. By relying on quantitative research methods to analyze the indicators selected from the theoretical framework, as well as building a virtual

model for a selected internal space, applying the selected indicators for internal spaces, flexibility and techniques, and testing them using a test list by the users of the selected space, i.e. the respondents to the space, to reach results either to support the research hypothesis, which stipulates the existence of a relationship. The influence between technologies and the flexibility of the interior space, and this relationship has a significant impact on shaping the final form of the contemporary interior space to achieve or refute alternative solutions to the space. (Fig.4.5)



**Fig. 4:** Studio space, the reality of the situation  
Source: Author



**Fig. 5:** the plan of the selected space  
Source: Author

The indicators were extracted from the previous literature. A selection of them were digitally built as shown in the table 1. Then, the 16 indicators were applied practically by designing a model for the studio space. The design of the model for the chosen space requires the use of Autocad 2020 program to draw the plan and 3Ds Max 2021 to make the 3D shape with the V ray 5 program for output. Then applying each of the selected indicators that were built, in order to achieve the goals, comprised the vertical elements symbolized by furnishings and dividers of the room.

The test on the case study consists of the users of the space: students and professors. Google forms were used in order to determine whether the indicators were appropriately implemented and whether the space is a flexible or not.

In the first design model, it was suggested to use sliding partitions with vertical rails to split the studio into three spaces, each of which serves a distinct purpose as indicated in the Fig. 6. In addition to the rotating and movable display screen through a horizontal rail to meet the needs of the user, the joint and container on an electronic screen also allows students' drawing boards to be foldable through the use of joint technology to provide spaces in the event of a job change. The third studio room served as a workshop for drawing and creating architectural models using appropriate furniture, while the second studio area served as a break for the students to sit through the use of foldable and retractable furniture for usage when needed.



**Fig. 6:** Design of the first model of the studio space  
Source: Author

The second design model, in this model, the space was divided into two functions using a partition that works with separation and merging technology by re-installing furniture pieces such as seating and tables to be a partition that separates two spaces with different functions, the function of the first space is as a studio for lectures that contains a table for professors to sit that can move and change size according to The user needs and contains a control screen, in this design , the space was divided into two functions using a partition that works with separation and merging technology by re-installing furniture items like seating and tables to be a partition that separates two spaces with different functions; the first space's function is as a studio for lectures and includes a table for professors to sit at that can move and change size according to The User needs and contains a control screen, Fig. 7.



**Fig.7:** the design of the second model of the studio space  
Source: Author

## Data Analysis

For analysis, data was entered into a master sheet and converted into digital language and analyzed using the statistical analysis program (SPSS, 25, 2023). The analysis application (T-Test) was approved to test the effectiveness of each of the secondary variables as well as the percentage of each An indicator relative to the rest of the indicators, where the successful variables that have a percentage higher than (35%) will be adopted in the analysis.

Classifying the variables with a percentage higher than (45%) as very strong, and the variables from (35-45%) as being effective. Excluding variables with percentages less than (35%) because they are very weak. (AL-Akkam et al., 2002).

## Findings

The results of the comprehensive analysis (T-Test) are as follows.

The results of the analysis show that there are 13 effective factors in this relationship. The highest percentage is X8 with a percentage of 43%, X12 with a percentage of 42.7%, X9 with a percentage of 42.2%, and X2 with a percentage. 39.7%, X13 39.2%, X7 38.6%, X14 37.9%, X1 and X11 37.6%, X10 37.2%, X3 and X15 36.1%, X16 35.4%.

The results of the analysis are as follows.

The effective variables for the comprehensive analysis represent X8 = 43%, X12 = 42.7%, X9 = 42.2, X2 = 39.7%, X13 = 39.2%, X7 = 38.6%, X14 = 37.9, X1 + X11 = 37.6%, X10 = 37.2, X3 + X15 = 36.1, X16 = 35.4%

## Partial analysis results (T- test)

It includes the results of testing all the indicators of the two models by making a questionnaire form for the respondent sample. Results are as follows.

X1 + X7 with a percentage of 54%, indicators X9 + X12 with a percentage of 51%, then X13 + X14 with a percentage of 48.6%, and the presence of 6 active variables represented by X10 + X11 with a percentage 43% percentile, X2 + X8 + X15 percentile 40%, and X16 percentile 37.8%.

While the results of the second model show that there is one strong variable represented by the indicator X4 with a percentage of 48.6%, in addition to the existence of 3 effective variables represented by X11 + X15 + X16 with a percentage of 43%.

From the above it is clear that;

- Strong variables of the first model X1 + X7 = 54%, X9 + X12 = 51%, X13 + X14 = 48.6%
- Active variables for the first model X10 + X11 = 43%, X2 + X8 + X15 = 40%, X16 = 37.8
- Strong variables for the second model, X4 = 48.6
- The effective variables for the second model are X11 + X15 + X16 = 43%. Note Table 2.

It is noted from the partial results of the two models that the indicators, X16, X15, and X11 are repeated twice, which means that they are strong and the rest of the indicators are invalid because they are not repeated.

**Table 2: the results of the comprehensive and partial analysis (T-test)**

Source: Author

N	Relationship indicator	The results of the second model		The results of the first model		Overall results		s
		actors	strong	actors	strong	actors	strong	
1	Space redistribution				*	*		<b>X1</b>
					*	*		<b>X2</b>
						*		<b>X3</b>

			*					<b>X4</b>
2	control							<b>X5</b>
								<b>X6</b>
3	Using the interior spaces				*	*		<b>X7</b>
					*	*		<b>X8</b>
					*	*		<b>X9</b>
					*	*		<b>X10</b>
		*			*	*		<b>X11</b>
					*	*		<b>X12</b>
					*	*		<b>X13</b>
4	Responding to user requirements				*	*		<b>X14</b>
		*			*	*		<b>X15</b>
5	reconfiguration		*	*		*		<b>X16</b>

The results of the comprehensive and partial analysis of the four models are noted from Table 2. The indicator, X15, X16, X11, is repeated three times, which means that it is strong, and the indicator, X1, X2, X7, X8, X9, X10, X12, X13, X14 twice, and the rest of the indicators. Are not repeated.

## Conclusions

The most important conclusions of the practical study can be identified, as 3 strong factors and 9 effective factors that were obtained in the comprehensive and partial analysis of the (T-test):

It is thus concluded that flexibility in the interior spaces is achieved by using techniques by deleting and removing the vertical elements represented by the partitions of the studio space and by using the sliding horizontal rail technique to achieve alternative solutions for the function of the space.

It is possible to achieve the principle of spatial redistribution by deleting and removing the vertical elements represented by the partitions of the studio space and by using the sliding horizontal rail technique to achieve alternative solutions for the space function.

- Diversity and multiplicity of furniture in the studio space can be achieved by using the technique of recombination, as in student chairs to meet the requirements of the user and to exploit the interior space.
- Flexibility in interior spaces can be achieved through elements such as furniture by providing spaces for them compared to traditional furniture and by providing alternative solutions for all furniture used in more than one way and for more than one function.
- Techniques are among the important modern means used in interior spaces because of their great impact in saving time and effort for users by meeting their requirements. They do so with the lowest possible cost and in the shortest possible time.
- Clarifying the types of techniques and the benefits of each, and clarifying which technologies are used in interior spaces that achieve flexibility.
- The interior space undergoes several changes in its formal characteristics to suit the changes and requirements of users through the use of partitions that operate with vertical and horizontal rail techniques.
- It is necessary to achieve a fundamental shift in the concept of using technologies in ceremony spaces, as well as taking into account the standards for using technologies in the interior design of the space.
- The studio space can be used for more than one function at the same time and according to the requirements of the users to exploit the spaces of the space.

- Spaces of different shapes and with different furniture can be created for the same space by dividing the space into more than one space using partitions.

The aim of the study was to reveal the impact of technologies on the flexibility of shaping contemporary interior spaces, and then the research recommends the following:

- Investing the results of the current research on the applied level in order to benefit from the design process in the interior spaces of the Department of Architecture at the University of Baghdad.
- The research also recommends enriching educational spaces with smart technologies to raise the level of functional, aesthetic and environmental performance.
- Emphasis on achieving internal educational spaces with high flexibility.

## References

- Agha, R.H. (2022) The possible application of intelligent systems in traditional courtyard houses in Iraq. *Applied Engineering and Technology* ISSN 2829-4998 Vol. 1, No. 1, pp. 11-23, Available at: <https://doi.org/10.3176/aet.v1i1.666>
- Al-Akkam, Al Tak. & Agha (2002) The Effect of Technology on Interior Design. *Journal of Engineering, Engineering College*, University of Baghdad, vol. 9, issue 1, pp.21-43.
- Deniz D. & Oğuz D. (2020) Digital technology, and interior architecture. *Mimarlık ve Yaşam Dergisi Journal of Architecture and Life* 5(2), p.p561-575. Available at: <https://www.researchgate.net/publication/348064285>
- Forsyth, J. C. & Anderson, S. (1982) Build for People, Build for the Future. *Open House International*. Vol. 7, No. 7.
- Salah H. (2019) The impact of the philosophy and ideology of contemporary interior design flexibility. *Journal of Architecture, Arts, and Humanistic Science*, No. 15, pp.54-65.
- Abdullah.I.& Raz, 2019, The influence of spatial flexibility to improve the sustainability of interior design by using smart technology (Case study –future smart home in Iraq). *Article in European Journal of sustainable development*, p.p 438-451. Available at: <https://www.researchgate.net/publication/337670376>
- James D. (2006) Building Adaptation. *Taylor & Francis Group*, simultaneously published in USA and Canada.
- Jose, C.,e tal, (2016) Smart interior design of buildings and its relationship to land use. *Architectural engineering and design management*, p.p 97-106. Available at: <http://www.tandfonline.com/loi/taem20>
- Oday Q. Abdulpader; Omar A. Sabah & Hussien S. Abdullah (2014) Impact of flexibility principle on the efficiency of interior design. *International transaction journal of engineering, Management, & Applied Sciences & Technologies*, Volume 5 No.3, p.p195-211. Available at: <http://TuEngr.com>
- SalahaddinY. B. & Aisha R. S.2020, Small spaces need smart solutions: impacts of smart interior design solutions on achieving flexible space. *International transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, Volume 11 No.6 ISSN 2228-9860, Paper ID:11A06J. Available at: <http://TuEngr.com>
- Senem, M.O. & Arıdağ, L. (2006) Ekolojik Tasarım Yaklaşımları Bağlamında. Türkiye'de Proje Yaklaşımları, *Uluslar arası Hakemli Tasarım ve Mimarlık Dergisi*, 9(1), p.p14-34.
- Shaba, G. (1986) Flexibility in design and its applications to regional buildings. *Building Research Journal*, Volume 5, Issue 1.
- Gavino Paddeu (2008) T-Frame: the design of a multiuser interactive wall. alessandro soro and gavino paddeu, 2nd wseas Int. *Conf on computer engineering and applications (CEA'08)* Acapulco, Mexico, ISSN: 1790-5117, p.p50-53. Available at: <https://www.researchgate.net/publication/234795586>

- Niva Mahanta (2020) Artificial intelligence for smart interiors – colors, lighting, and domotics, International Conference on Reliability, *Infocom Technologies and Optimization (Trends and Future Directions)* (ICRITO). Available at: <https://www.researchgate.net/publication/344981744>
- Agha, R. H. (2001) The Impact of Technology on the Relationship of Form to Origin in the Language of Contemporary Interior Spaces, Master Thesis, Department of Architectural Engineering, University of Baghdad.
- Agha, R. H. (2016) The Role of Intelligent Systems in Traditional Courtyard Houses in Baghdad, Iraq, Newcastle University.
- Al Mudarres, R. M. S. (2003) Technology and Architecture: The Impact of Technology on the Uniqueness of the Architectural Idea, Master Thesis.
- Al-Niajidi H. (1985) Flexibility in the Design of Building. Ph.D. thesis, Oxford Polytechnic Oxford.
- Al-Numan, R. S. A.(2003) Design Characteristics Affecting the Flexibility of Movement in the Interior Spaces of University Buildings, Master Thesis, Department of Architectural Engineering, University of Mosul.
- Leonardo, A. Bonanni (2005) Design of intelligent interiors, Thesis for the degree of Master of Science at the Massachusetts Institute of Technology.
- Maja G. (2015) Flexibility and comfort in limited dwelling interior, Ph.D. Thesis, Department of Architecture and Urban Studies (DAStU) ,Politecnico di Milano.