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ADAPTABILITY OF SPACE IN THE FUTURE OF ARCHITECTURE: FUNCTION TRANSFORMATION

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Abstract. The multifaceted developments in the globalizing world necessitate change and transformation and therefore the need for adaptation, to ensure permanence in architecture. The concept of adaptability in architecture is that the structure is open to change in response to the needs of changing and evolving user groups; allows spatial and functional arrangements to support different uses and functions and adapts to modern technologies without major intervention in existing activities and the environment. However, today, the fact that architectural structures cannot adequately respond to changing needs and that the concept of transformability is not addressed systematically enough in the design processes emerges as an important problem. The purpose of this study is to convey through examples that adaptability will have an indispensable place in the future of architecture. The sample was selected from award-winning buildings whose quality was registered to meet the need for different functional spaces. In conclusion, the concept of adaptability offers solutions to needs arising from positive or negative situations and has a key place in architects' future-oriented designs. By repurposing old and idle buildings, new job areas can be created, contributed to regional development and a platform can be created to ensure social harmony.

Keywords: *Adaptability, architecture, function transformation, future of architecture, space.*

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1. Introduction

In the globalizing world, rapid and continuous changes in social, technological, environmental, cultural and economic areas make the need for growth, change and transformation in architecture inevitable. These dynamic developments reveal the necessity to constantly re-evaluate and adapt architectural practices and approaches.

While technological advances encourage the use of new materials, construction techniques and design methods in architecture, issues such as sustainability and energy efficiency also occupy a key place on the agenda of architects. Green buildings, energy-efficient structures and environmentally friendly design approaches are increasingly finding a place in architectural practice as a reflection of environmental responsibilities.

Social and cultural changes require architectural projects to be designed in accordance with user needs and social expectations. Urban transformation or the or the reshaping of living spaces and public areas, necessitates the integration of social needs and values into architectural design. In addition, in multicultural societies where diverse cultural and social groups live together, architectural projects are expected to play a supporting role in cultural diversity and social harmony.

In this context, the study, because of technological, social, environmental, cultural and economic developments and changes experienced over time, is aimed at opening a discussion on how important adaptability will be in architecture in the future and to examine it through examples. In line with the purpose, the study sample was selected from award-winning buildings that have been registered as meeting the need for different functional spaces. The buildings were selected from the Architectural Review New into Old Awards 2023 and RIBA Regional Awards 2023 adaptable reuse projects, which are important project awards in the field of architecture. The sample was limited to five buildings with distinct functions from among the projects that were finalized during the study.

2. Adaptability and Architecture

The word adaptability is defined in the dictionary as adapting, making suitable for a certain use or situation or having the possibility of adaptation. In short, adaptability is the ability to change or be changed to suit similar conditions (Ross *et al.*, 2016). The exact definition of building adaptability is considered a controversial point (Watt *et al*., 2023). Adaptability is remembered with the concepts of mobility, adaptation, flexibility, modularity, transformation, change, growth and adaptability (Kızmaz & Koş, 2015; Pinder *et al*., 2017). Adaptation, in relation to existing buildings, traditionally has a narrower meaning that suggests a type of change of use (Douglas, 2006). Adaptability in architecture is the ability to meet various usage needs, to be flexible in spatial and functional arrangements, to adapt to change by keeping up with new technologies without disrupting the existing structure and environment to a great extent and to extend the life of the building (Nakib, 2010; Watt *et al*., 2023). Friedman (2002) defined adaptability for houses as “providing residents with forms and tools that facilitate adaptation between spatial needs and the constraints of their homes, before or after residence”. The concept of adaptability in architecture emerged with modernism (Acharya, 2013).

Adaptive architecture has emerged as an approach to the design of buildings that considers the possible need for modification or adaptation throughout the life of the building, according to Habraken's definition of the open building concept (Habraken, 1972). Habraken's idea of openic growth and urbanization are the main driving forces that increase the necessity of urban renewal programs in modern and developed countries. Building design has attracted attention in terms of the economic dimension of sustainability. Economic growth and urbanization are the main driving forces that increase the necessity of urban renewal programs in modern and developed countries. Building adaptations constitute an important part of urban renewal plans, especially in historical areas and mass housing (Douglas, 2006). Adaptive buildings are a promising facilitator in the transition to a more circular economy with the aim of using materials as efficiently as possible (Manewa *et al*., 2016; Seuntjens *et al*., 2024). Structures that allow flexible use can be used more widely, which increases their economic value (Wang *et al*., 2019). In this sense, adaptable design structures are extremely important in terms of sustainability (Askar *et al*., 2021).

Adaptability in architecture is the ability to postpone the demolition phase of a building, extending its useful and/or desired lifespan through the “ability” to change, adapting itself to new, different conditions and ensuring sustainability by extending the number of cycles in which users can see their needs met (Schmidt III & Austin, 2016). Adaptability in architecture is an orientation that also serves design thinking for deconstruction. For adaptability, buildings should not be considered static structures but rather dynamic and open structures that can easily adapt to changing needs. Furthermore, the fixed function-material relationship in buildings should be separated through the design of reconfigurable systems (Durmisevic & Yeang, 2009).

The British Standards Institution (BSI, 2020) recognizes the importance of the adaptability approach and proposes three principles of adaptability. These are: versatility, transformability and expandability (BSI, 2020). Kanters (2018) has identified several broad principles regarding adaptable building design. These design principles support the adaptability of a building, which will ensure its long-term use. Although it is mentioned that the design of the building should preferably be modular and simple, although complex shapes make the deconstruction of building materials and components complicated, this does not affect the freedom of designers (Kanters, 2018; Tokgöz & Koçak, 2008).

Adaptable structures can be grouped as design-based or process-based (Ross *et al*., 2016). Adaptable design is a new design paradigm that aims to create designs and products that can be easily adapted to different requirements. Adaptability in designs that will form the future of architecture is a crucial factor in creating spaces that can meet changing needs and adapt to time (Gu *et al*., 2004). With designs made in this way, spaces can be used in multiple ways without any physical changes and become adaptable and flexible. Adaptable architectural design offers more potential for larger-scale changes over extended periods of time without reducing diversity or making things unnecessarily costly or complicated (Leaman *et al*., 1998). There are two approaches at the core of the concept of adaptability (Figure 1). One of these approaches is the field of adaptation of existing structures to changing conditions or their change to provide this adaptation.

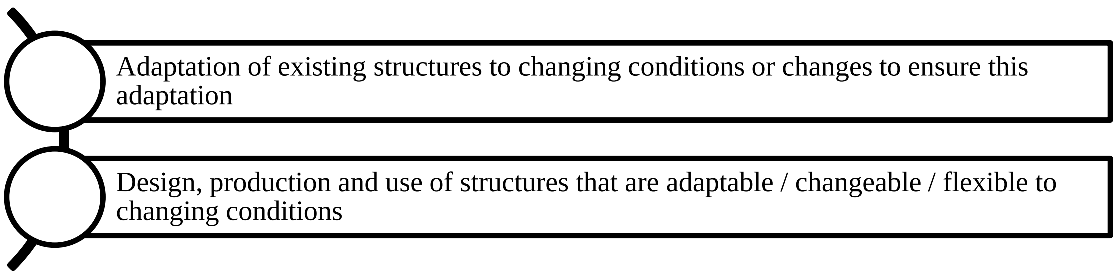

Figure 1. Adaptability approaches

There is still uncertainty about which physical design strategies can be used to ensure adaptability (Kanters, 2020). This study investigates how adaptability is achieved through existing public structures that change their function to meet spatial requirements and how it can guide the architecture of the future. Another approach is the production, design and use of new structures that are changeable, flexible or adaptable to changing conditions. While the first approach aims to meet the current need with existing ones, the second approach aims to carry out the design and construction processes of the spaces that will be needed for the future increase of the situations encountered in the first approach and the integration of daily life into it (Figure 2).

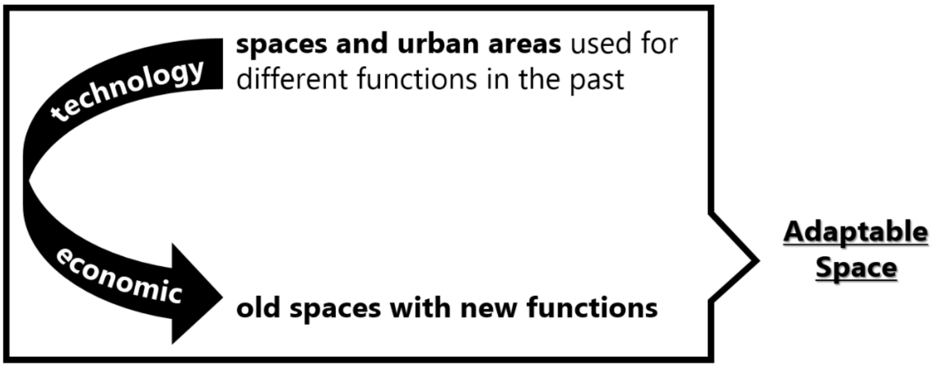

Figure 2. Adaptable space production process
Source: Produced by the authors

In the health and natural disaster-related problems experienced, various spaces and areas where spaces will be placed have been needed. In this context, it is seen that the principle of adaptability is used in architecture to meet various human and spatial needs. The need for the concept of adaptability and the connection established with the future constitute the basic problem of the study. To meet these needs, the functions of spaces and urban areas used for distinct functions in the past have been adapted to new functions. Apart from the negativities experienced, it is seen that the concept of adaptability has come to the fore in architecture in line with the positive developments in technology and economy, different material uses, different space searches and flexible space-friendly needs. Within the scope of the study, the concept of adaptability is examined and conveyed through examples.

3. Method

The purpose of the study is to convey through examples that adaptability will have an indispensable place in the future of architecture with the technological, social, environmental, cultural and economic developments and changes experienced. There are changes and transformations in space with the positive and negative developments brought by age. In this context, it is seen that the principle of adaptability is used in architecture to meet various human and spatial needs. The need for the concept of adaptability and the connection established with the future constitute the basic problem of the study. The study is based on a case study, which is a qualitative research method. Case studies are mostly research designs in which a situation, event or phenomenon is examined in detail (Creswell, 2017). The sample was selected from award-winning structures that have been registered to meet the need for different functional spaces. No structure or type of structure was selected as a limitation in the sample. The reason for this is to emphasize that various public spaces should have the quality to meet the need for different functional spaces.

Following the examinations, the functions that will meet the basic needs of the structures of the future were emphasized. To meet these needs, the functions of the spaces and urban areas that were used for different functions in the past were adapted to new functions. Apart from the negativity experienced, it is seen that the concept of adaptability in architecture has come to the fore with the positive developments in technology and economy, in line with the use of varied materials, different space searches and the needs suitable for flexible spaces. Within the scope of the study, the concept of adaptability is examined and explained through examples (Figure 3).

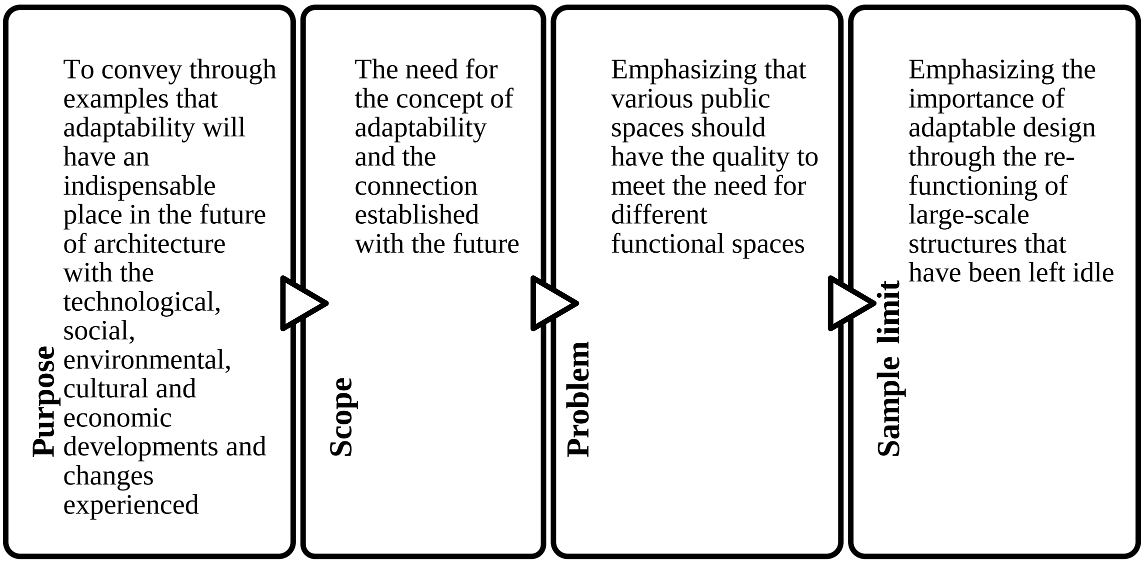

Figure 3. Design of the study
Source: Produced by authors

Certain criteria were adhered to in the selection of the sample. The projects constituting the sample boundaries were selected from the Architectural Review New into Old Awards 2023 and 2023 RIBA (The Royal Institute of British Architects) Regional Awards adaptive reuse projects. The reason for this is that the projects awarded in 2023 were selected with the theme of the need to rebuild communities and find sustainable application methods. In addition, importance was given to examining adaptation projects designed with different functions. In this sense, it was thought that the diversity in design decisions resulting from the space requirements that vary depending on the functions would add a different dimension.

The AR New into Old Awards have been celebrating creative appropriations of existing buildings since 2017, from innovative additions to ambitious adaptations. As the need for sustainable alternatives to redevelopment becomes increasingly urgent, the AR New into Old Awards celebrate creative ways in which buildings are being adapted and remodeled to meet new contemporary uses. RIBA (The Royal Institute of British Architects) is a body that promotes excellence in architecture, with the aim of delivering better buildings and spaces, stronger communities and sustainable environments. The award-winning body, which awards under a range of sub-themes, will announce the 2023 winners for the theme of adaptability in May. The sample buildings include the Nieuw-Lekkerland Water Tower, Shrewsbury Flaxmill Maltings, La Laguna and Houlton School. These structures have been used as water towers, factories and radio transmitters and have been repurposed as homes, cafes and social facilities, workshops and schools. Details of the structures are provided in Table 1.

Table 1. Information on the projects constituting the sample

Building name	Building's location	Function year	Old function	New function
Watertower Nieuw-Lekkerland	Lekkerland, Netherlands	2020	Water Tower	Housing
Flaxmill Maltings	Shrewsbury, England	2022	Factory	Cafe and Social Space
La Laguna	Mexico City, Mexico	2023	Factory	Trade Workshop
Houlton School	Warwickshire, England	2021	Radio Transmitter	School
Site Verrier	Meisenthal, France	2022	Glass Factory	Cultural Center

4. Results

In this section of the study, information is given about the processes of acquiring new functions in the adaptation projects discussed.

4.1. Watertower Nieuw-Lekkerland

The Nieuw-Lekkerland water tower was built in 1915 in the Nieuw-Lekkerland region of the Netherlands. In 2020, it was converted into a residence for two families. This transformation project won the Dutch Watertower Prize in 2021. The problem of creating new openings for daylight on the facade while preserving the original character of the water tower was addressed. After a detailed study, it was concluded that diamond-shaped windows were important to emphasize the special character of the water tower. For this reason, it was decided to place the newly planned openings around the existing diamond-shaped windows and to preserve these special details. The hexagonal tower is designed with a diameter of nine meters and has a garden, residential floors and storage areas placed above the entrance. The floor plans are organized using various fittings, zoning areas and boundary elements. Thanks to these arrangements, flexible use is achieved in the relationships between spaces. To meet the new functional requirements, an elevator and new stairs were added to the tower (Göncüoğlu, 2021; Transformation Watertower Nieuw Lekkerland, 2024; Watertorenprijs, 2020) (Figure 4).

Figure 4. Exterior and interior photos of Nieuw-Lekkerland Water Tower
Source: (Url-1; Url-2)

4.2. Flaxmill Maltings

Flaxmill Maltings operated as a steam-powered flax mill for around one hundred years, later becoming a malt mill and serving briefly as military barracks during World War II. Purchased by Historic England in 2005, the mill has been repurposed as an adaptable workplace, café, social enterprise center and leisure space as part of a heritage regeneration project. The complex comprises eight buildings, three listed as Grade I, two listed as Grade II* and three listed as Grade II. The existing structural features and the many alterations to the internal floor have led us to conclude that the pyramidal malt kiln should be used as an entrance to provide access to the upper floors and vertical mobility. It provides flexible offices, work and meeting spaces for around 360 people. Engineers developed alternative support as a new method of reinforcing the walls around the existing supports. The structure has been restored and repurposed in line with the principles of development, it is aimed at reducing all kinds of waste while meeting a fixed budget and high-quality standards (Shrewsbury Flax Millmaltings, 2024; Tutav, 2023) (Figure 5).

Figure 5. Exterior photographs of Shrewsbury Flaxmill Maltings
Source: (Url-3; Url-4)

4.3. La Laguna

La Laguna is a former textile and yarn factory built in the 1920s in the Doctores district of Mexico City. The factory structure, which was in poor condition, was rehabilitated for public use. The factory has been transformed into a complex that includes more than twenty-five different productive and creative firms. In addition, production-oriented functions such as carpentry and textile workshops, coffee production facilities and ceramic studios have been added. The original exterior facade has been preserved with intact window systems and the interior is shaped around two courtyards where most of the equipment and the annex are located. An earthquake in 2017 was the trigger for the consolidation of Laguna México as a trade workshop project. The green color was frequently used in the project, in the architectural details of the old building and in the antique weaving machines (Karaağaçlı, 2013) (Figure 6).

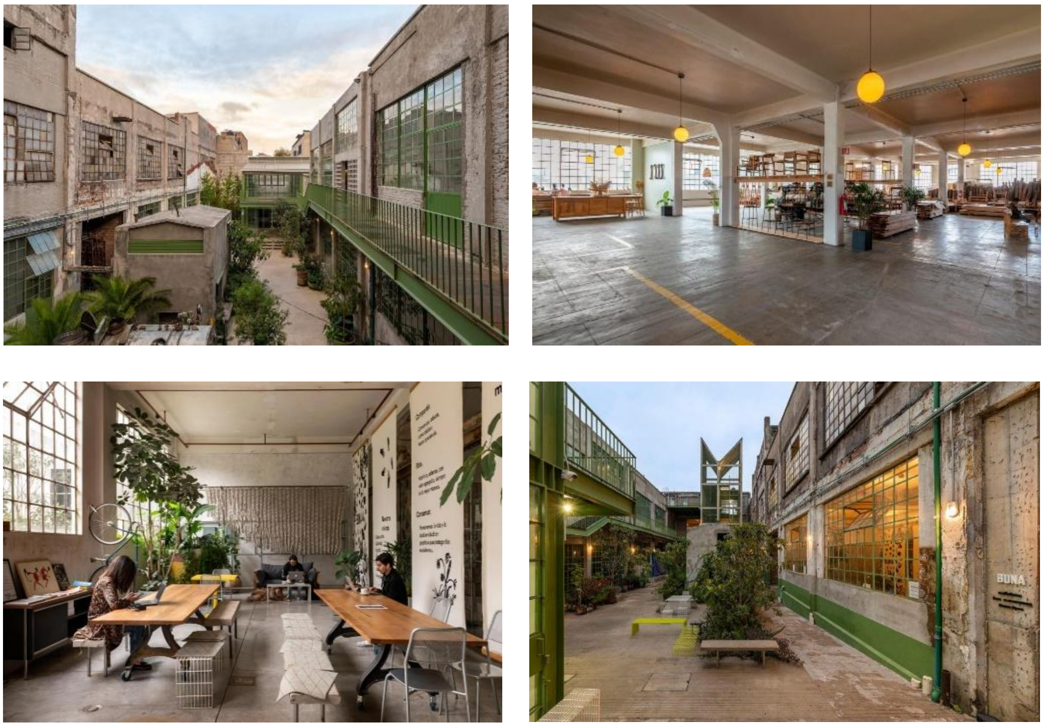

Figure 6. Exterior and interior photographs of La Laguna
Source: (Url-5; Url-6; Url-7; Url-8)

4.4. Houlton School

Houlton School has been converted into a radio transmitter building. It has won the RIBA Award for “buildings that have been creatively reused to improve their environmental, social or economic sustainability”. “As architects seek to minimize carbon emissions by re-using existing structures, examples of re-use such as this are more important than new designs”. The restoration and re-use of the two main blocks have created a modern school that can ‘work with an old building’. As you enter from the new main entrance under a canopy to the south-east, the old Power Block, on the left, has been adapted to house dining and assembly rooms. Two ‘cathedral-like’ spaces, one of which is almost 12 m, have been heavily modified to provide art and music rooms, a library and sixth-form areas (Cano, 2023; Karaağaçlı, 2023; RIBA Reinvention Award, 2024; Williams, 2022; Wormald, 2021) (Figure 7).

Figure 7. Exterior and interior photographs of the Houlton School
Source: (Url-9; Url-10)

4.5. Site Verrier

The historic glass factory Site Verrier de Meisenthal, which dates to the 18th century, has been adapted into an active, publicly funded cultural center. The functional transformation was completed in 2022 and was awarded the AR New into Old Awards 2023. The complex, which covers a total area of 14,000 m^2, includes a cultural center, a visitor center, a black box theatre, an art depot, offices, workshop spaces, classrooms, a café and a restaurant. It houses three separate institutions, the independent but interconnected Glass Museum (Musée du Verre et du cristal), the CIAV (Centre International d'art Verrier) - an international glass art center where traditional craftsmanship meets contemporary practices - and the Cadhame (Halle verrière) - a multidisciplinary cultural space hosting art installations, events and concerts. The undulating concrete surface, cast in situ in the factory garden, is designed to both unify the buildings and reference glass production. It also functions as a roof, ceiling and wall that connects the ground floors of the buildings to frame a public plaza. Functions in the existing building have been redesigned and expanded. A new entrance has been added to a previously unused basement, creating a 500-seat venue that can be used as a 700-seat theater or a 3,000-seat concert hall (Url-11; Url-12).

Figure 8. Interior photographs of the Site Verrier
Source: (Url-13; Url-14)

5. Discussion

In today's architectural practice, the concepts of transformation, reuse and sustainability are becoming increasingly important. In this context, the Watertower Nieuw-Lekkerland, Flaxmill Maltings, La Laguna, Houlton School and Site Verrier projects that are considered demonstrate how both architectural adaptability and sustainability goals can be achieved by re-functioning existing structures on different levels (technological, cultural, social).

Watertower Nieuw-Lekkerland, an example of the transformation of industrial heritage into housing, is a strong example of technological and spatial adaptability. While the original cylindrical form of the building is preserved, the interior organization has been rearranged according to the residential function. This transformation offers a sustainable strategy in terms of energy efficiency and reuse of existing materials. The building supports cultural sustainability by referencing local memories at the same time.

Flaxmill Maltings, dating from England's industrial revolution, has both technological and cultural adaptability. The building, which is of historical importance as the first iron-framed building, has been converted into an office, exhibition area and museum. During this transformation, the structural features of the building were preserved and supported with energy efficient systems. Flaxmill Maltings supports social sustainability thanks to its functions that also encourage public participation and sets an example for the integration of industrial heritage with contemporary life.

The social housing project in La Laguna is an example where social and climatic adaptability is evident. Designed in accordance with tropical climate conditions, the structure offers solutions such as passive air conditioning strategies and natural ventilation. The flexible structure of the housing units allows users to adapt to different lifestyles at the same time. In this respect, the project prioritizes social sustainability in line with the principles of social equality and user participation.

The Houlton School project, which is the conversion of an old radio broadcasting building into an educational structure, is a strong example of educational, cultural and spatial adaptability. The preservation of existing structures and their transformation according to contemporary educational needs provide both material and symbolic sustainability. This structure supports spatial continuity and community belonging by assuming a contemporary public function while establishing a connection with the past.

Site Verrier, the transformation of this historical complex identified with the glass industry into a cultural, artistic and production center encompasses cultural, economic and technological adaptability. While the physical structure of the industrial heritage is preserved, new functions are added and local glass production is supported. Site Verrier both stimulates the local economy and ensures the continuity of traditional craftsmanship. In this way, it contributes to the sustainability of local culture and functions as a multifunctional center for tourism and creative industries.

6. Conclusion

The sample that constitutes the scope of the study consists of adapted products of abandoned buildings. With the inclusion of adaptability in the building program, buildings have been used more effectively in changing conditions without compromising comfort. The existence of adaptable architecture has gained importance to ensure sustainability, which has a prominent place in the architecture of the future. With the attempts of designers towards adaptive design that can respond to changing needs, designs emerge upon their attention. In this sense, the increasing number of design competitions for adaptable designs is an indication that they will continue to be among the current issues.

The financial burden (labor and material) brought by the construction process of a new building causes a decrease of resources depending on the need for use and the increase of dysfunctional structures. Adapting existing and abandoned buildings to new functions to keep the building stock in balance contributes to ensuring sustainability not only environmentally but also economically. In this sense, priority should be given to the renewal of the existing building stock according to its durability and demolition status. Such transformation projects encourage the reevaluation of abandoned buildings and the efficient use of resources. At the same time, the preservation of historical and cultural heritage and its transfer to future generations are also an important part of such projects.

The five examples examined support the social, cultural, economic and environmental dimensions of sustainability by developing adaptability strategies at different levels. Technological improvements, spatial flexibility, protection of cultural heritage and sensitivity to social needs are the main factors that ensure the success of these projects. Therefore, such transformation projects reveal the necessity of addressing sustainability in architectural practice with a multidimensional understanding, without reducing it to energy and environmental parameters only.

Presenting the structure to the user experience ensures that the local public, the administration and non-governmental organizations (NGOs) are included in the process. This means that the project supports not only physical but also socio-cultural sustainability. The participation of the local community in such projects allows the preservation of local culture and values, the increase of social participation and the revitalization of the local economy.

In existing multi-functional spaces, furniture supports the adaptability of the space by being moved around the space surfaces. A coordinated system can be created with modules that allow for variability in size within the core. In the re-functioning process, flexible spaces should be designed to ensure that adaptability is more optimal and that it adapts to the new function needed in the future (Figure 9). This situation may lead to a tendency towards the production of single-type structures. However, no structure can be the same even if it is designed based on a single type.

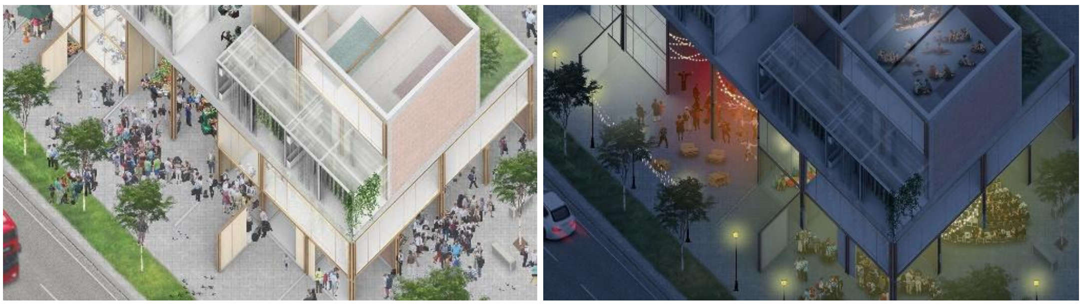

Figure 9. Functional space transformation with adaptability
Source: (Url-15; Url-16)

By re-functioning old and idle buildings, new job opportunities can be created, regional development can be contributed to and a platform can be created for social harmony. Such transformation projects will contribute significantly to the sustainable development of cities and regions and will help create a more livable environment in terms of social, economic and environmental aspects. In addition, various spaces and areas where spaces can be placed are needed in health and natural disaster-related problems that occur on a global or local scale. To meet these needs, the functions of spaces and urban areas that were used for different functions in the past have been adapted to their new functions. Apart from the negative developments experienced, it has been seen that the concept of adaptability in architecture has come to the forefront with the use of different materials, different space searches and flexible, space-friendly needs.

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