ADAPTIVE REUSE OF ABANDONED INDUSTRIAL BUILDINGS WITH THE HELP OF ARTIFICIAL INTELLIGENCE

Abstract

All built environments and buildings are proof of humanity and history. Even if a building does not have a crucial value, still it may have value as a heritage because it is a link between the past and today. In addition to buildings, cities are also a collection of urban memory. Urban memory is an important concept for cities because they are the real cultural heritage of humanity. With the help of cultural heritage, all urban memory can be transferred to future generations.

In the continuity of time, in societies, while the needs of people change, the places are shaped according to the time and context they belong to, and therefore the structures also change. Since the acceleration of this change, we live in today is constantly increasing, new requirements arise, and new structures are constructed following these needs.

While new buildings were built for new needs, the old buildings became useless and abandoned. Industrial buildings especially become abandoned much faster if they are compared with other buildings. Because they need a change of space with changing technology and industrial infrastructure. However, these abandoned structures were part of cultural continuity and social identity. That existing fabric is among the most important cultural assets. It is important to protect it and to function accurately. The protection of cultural assets also contributes to cultural sustainability. In terms of conservation, not only historical buildings but the whole environment should be used as a resource. For this reason, in order not to lose cultural heritage, buildings should be protected by adaptive reuse even if they lose their functions. Even though the buildings lose their functions, they may mostly preserve their structural features, so they might be suitable for adaptive reuse.

While these structures are preserved, each architect, designer, engineer, or even contractor approaches them from a different point of view, and while some structures continue with the same functions, others take on completely different tasks. In this context, when the sustainability of the buildings is considered, the buildings that are exposed to faulty processes lose their originality, identity, and cultural features.

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Figure 1: Scheme of the Study. (Source: Author.)

At this point, the adaptive reuse of abandoned industrial structures, which may remain in the centers of cities over time and are in the form of building stock, whose destruction will cause ecological and economic damage, gains great importance. In the process of functioning buildings with the wrong methods and by choosing the wrong functions, damage or even losses may occur in the structures. For this reason, the necessity of artificial intelligence and the new technologies in the re-functioning become a very important topic day by day. Therefore, this paper will discuss how artificial intelligence and new technologies can help people to preserve their social identities in the built environment without any or minimal damage.

Introduction

Since societies began to transform their economies into industry-based economies, buildings began to lose their functions along with changing economic and technological needs. However, cities are not just built areas without any interaction with humanity; they are living archives of human history and culture. When the concept of cultural heritage is considered, it should be integrated into all the strategies that are related to the city and its development. It is a multi-layered concept that contains a collection of human creations (Chiang & Deng, 2017). Cultural heritage covers both tangible and intangible values, and one of these values is urban memory.

Urban memory is totally related to urban structures like significant buildings, museums, monuments, etc. (Molavi et al., 2017). It is of great importance to record, remember, and transfer to the future all kinds of events, people, images, places, sounds, smells, and similar items that are consciously accumulated in individual or collective urban memory with the help of structures (Unlu, 2017). Every structure in the cities acts as evidence of the past. Memories are one of the most important building blocks of social and cultural identity. Therefore, cities are the symbols of urban memory. Urban memory is a type of understanding that derives from cultural memory. Cultural memory can be defined as a multidisciplinary term that contains psychology, sociology, geography, and built environments (Hussein et al., 2020).

The notion of 'urban memory.' which is closely linked to buildings like landmarks, museums, monuments, and more, highlights the importance of documenting and preserving the various components. As it is looked at how the industrial revolution shaped architectural development, it can be better understood how structures have played a key role in shaping and interpreting urban memory. During the industrialization period, the texture of the city underwent great changes, and an industrial structure was created. With the development of technology, machines have replaced human power in production, With the change in production methods, the production areas also changed, and a mechanical-scale industrial structure was created (Mengüşoğlu & Boyacıoğlu, 2013).

The main issue is that the abandoned industrial buildings will lose their values and heritage if they are demolished. Since the size of industrial buildings is mostly larger than other typologies, it is very important to reuse them. To maintain their social, ecological, and historical value, refunctioning is an essential solution while keeping the building itself. However, if the new function chosen does not fit properly, then the building may become useless and functionless over time. At the end of this reuse process, the result may be the loss of cultural properties. Therefore, there should be artificial intelligence support to detect the best solution and function for the buildings (Figure 1).

Methodology

Two methods were adapted to the study in line with the data required to be obtained to solve the above-mentioned problems. In the beginning of this study, data is analyzed through a literature review and the effective use of artificial intelligence technologies in the process of refunctioning industrial structures that have lost their functionality. In the research, trends and discussions in the literature are specifically addressed, including the growing importance of cultural heritage, the heritage experience, adaptive reuse, and technological advancements in the preservation area. Secondly, there are details of artificial intelligence and the most proper sub-branch of it, which is machine learning.

Adaptive Reuse and Artificial Intelligence

ADAPTIVE REUSE

Recovering buildings that have lost their function can only be done by refunctioning and renovating them. It is important to use these methods because they are not only good for the country's budget, economy, or ecological sustainability, but also because these buildings are part of the country's architectural and cultural heritage. That's why it's important to re-functionalize industrial buildings that were built at a really high cost during the time they were built and bring them back to life.

Adaptive reuse is defined as the improvement of an existing building that has lost its original function and reusing it with another function to have better financial, environmental, and social value (Bullen, 2007). As DEH (2004), mentioned in their works, well-made adaptive reuse of historic buildings is very beneficial for society because, in this way, they can restore and maintain the value of the building. Preserving cultural continuity and social identity is very important for every society. Adapting an abandoned building to the city with a new function might be helpful to maintain cultural sustainability.

In addition to these, adaptive reuse is an environmentally friendly architectural and urban planning principle. This method can be used with the repurposing of abandoned buildings and spaces by keeping their historical, cultural, and architectural significance. However, in the topic of adaptive reuse, there may arise some common issues. The first one can be summarized with recent building codes and regulations. Because codes and regulations may have some revisions since the day it was built. Therefore, they might need some adjustments and updates in the codes. The second problem is the structural and special integrity of the new function. Abandoned buildings, especially industrial functioning ones are large-scale buildings and if they are abandoned, they might cause a large space consumption. In addition to this information, designers, architects, and whoever is responsible for renovating or retrofitting, should balance the preservation of historical and architectural importance with the practical requirements of the new utilization, posing a challenge. To be able to fit these requirements, designers should consider all challenges like regulations, codes, and integration of the new function while preserving historical and architectural importance. In this regard, when integrating a new function into an old structure, the appropriate function should be selected according to the structure. Not every function can be suitable for every structure. Therefore, in the light of developing technology, using artificial intelligence may be helpful for designers to decide the best functional options.

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is defined as a machine that thinks and acts like a human brain. It can understand, decide, offer, solve problems, etc. in an intelligent way. AI is also a transmission of human behavior to the machines (Asa B. Simmons & Steven G. Chappell, 1988). When it is called Artificial Intelligence, since intelligent system design is such a large area, there are several subfields within AI that concentrate on various disciplines (Lawson et al., 2021). Several of the most significant AI subfields include machine learning, under the machine learning, neural networks, and decision trees, and deep learning is covered by all these (Figure 2).

Machine learning is a branch of artificial intelligence that focuses on simulating human thought processes. It works with algorithms to learn a task by using different data sheets to simulate human reasoning. Nowadays, machine learning works as a primary area of AI. It has emerged as the primary field of artificial intelligence with the goal of improving performance through the accumulation of data experience (Lawson et al., 2021). Algorithms for machine learning are computer-based statistical techniques that should be trained to identify common patterns in large volumes of data (Landolfi et al., 2021). In machine learning (ML), computers are learning data models and algorithms to make predictions based on information that is given.

Nowadays, in the cultural heritage field, artificial intelligence has recently started to be used in the preservation area. There are a lot of methods to use AI in this area. Automated scanning, 3D modeling with GIS (geographical information system), and Virtual Reality Applications (Akyol & Avcı, 2023). In the adaptive reuse area, it is quietly different than conservation. Because in preservation, it is mostly about scanning and documenting the sites but, in adaptive reuse, AI can be an option to offer the most suitable function of the space.

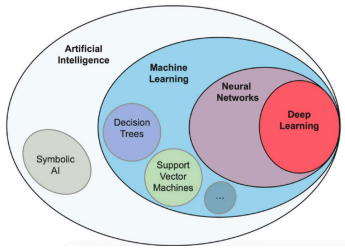

Figure 2: Scheme of Artificial Intelligence Subfields. (Source: Lawson et al., 2021.)

EXAMPLE: ADAPTIVE REUSE OF ABANDONED INDUSTRIAL AREA

There are many adaptive reuse case studies. However, a substantial change in the strategy for maintaining and improving a historic area may be seen in Toronto's Distillery District. Previously called Gooderham & Worst Distillery, it was an alcohol production factory. By that time, the factory was bought by another company and moved to another location. Because of this, the Distillery District became a useless and abandoned area. In 2001, it was realized that the area had tremendous potential with its historic architecture and location so this was seen as an opportunity to function as a shopping and residential region (Abusaada, 2015). This renovated project has many positive and negative aspects.

In terms of positive aspects, adaptive reuse strategies in this area largely focus on the architectural and structural components of converting an old industrial complex into a modern cultural center. Firstly, the adaptive reuse strategy in Toronto's Distillery District is very important in terms of historic preservation. Because they created a cultural and business area out of a group of historic structures that were formerly a part of the Gooderham & Worts Distillery. The renovation maintained the industrial site's 19th-century architectural history (Figure 3). Secondly, this refunctionalization contributed to the city in terms of economy. This structure is an example of how the creation of new urban areas through adaptive reuse is changing the symbolic meaning, purpose, and economic development of abandoned industrial areas in particular (Mathews & Picton, 2014a).

Figure 3: View of the Tomkins-Perkins Mill (LeBreton Flats). (Source: Mathews & Picton, 2014b.)

In contrast, the project has many challenges that might come with gentrification, shortage of affordable housing and commercialization in metropolitan areas when such changes take place (Mathews, 2010). As a result of the Distillery District's change of function, the surrounding area has gone through a process of commercialization and gentrification, causing property values to increase, and making it unaffordable for some residents.

Conclusions

The article begins by defining the concept of urban memory, cultural memory, and heritage and how it relates to industrial buildings. It then goes on to explain the advantages of adaptive reuse, including its ability to protect cultural heritage, its eco-friendliness, and its economic growth potential. Finally, it explains how AI can support adaptive reuse by identifying the best new uses of industrial buildings.

Examining the role of adaptive reuse in Toronto's Distillery District, in the literature there are many conflicts about the project. It has both positive and negative aspects. In the way of preserving and improving the space, it has many potentials. On the other hand, the refunctionalization of the district caused many problems like gentrification, housing, etc. Therefore, function selection is very important in adaptive reuse so there should be a system that suggests a new function to the designers. This system can be created by artificial intelligence.

In short, the study argues that AI has the power to transform adaptive reuse by improving its efficiency and effectiveness. AI can analyze large datasets of information about industrial buildings, including their architectural features, location, and history. This information can be used to identify promising new uses for each building. Additionally, AI can help develop new technologies to renovate and retrofit industrial buildings.

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