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Evaluation Criteria for Adaptive Reuse of Heritage Buildings to Assign Educational Use; Case Study: School of Conservation and Restoration*

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ABSTRACT

Although reusing buildings has always been considered throughout the history of architecture, this concept was raised as one the most effective methods of conversation and achieving sustainable development since the 1960s. While preserving the cultural heritages, subsequently, the history and identity of the society, this approach provides a ground for meeting people's daily needs. Also, using this approach leads to preserving the buildings for the next generations while keeping them away from being abandoned and useless. Despite the numerous experiences in this regard, many adaptive reuse projects do not achieve the success desired by designers because the building capacity to accept the new function or the functional needs of its surrounding environment is not given enough attention. Therefore, the current paper sought to present a proper method for decision-making by considering the influential components in this process. This study applied a mixed approach, the logical reasoning strategy, and content analysis in the qualitative part, based on the library resources and relevant international conventions, re-reading and analyzing the influential factors and criteria in the adaptive reuse approach. Thus, it prioritized the influential criteria in the adaptive reuse process to assign the educational land use to the building using the experts' and specialists' opinions, the Multi-Criteria Decision Making method (MCDM), and Super Decision Software. In this regard, based on the survey of experts, three historical monuments, including Darolfunun School, Etehadieh Historical House, and Negarestan Museum Garden, were selected as the proposed options for the School of Conservation and Restoration to be assessed and ranked based on the stated criteria. Finally, after assessing the final scores and presenting the most appropriate building to meet the considered functional need, the weaknesses and strengths of the selected option were investigated in the reuse process. The current study attempted to study another way of the reuse approach by raising the proper space to assign to the considered function through which the feasibility and capacity assessment of several valuable historical and cultural monuments to assign the considered land use was done based on the extracted criteria. The significance of these criteria was also considered based on the required uses (educational use).

Keywords: Adaptive Reuse, Changing Function, School of Restoration, Multi-Criteria Decision Making (MCDM), Conservation.

* This paper is taken from the first author's thesis entitled "Adaptive Reuse Criteria Measurement of Heritage Buildings (Case Study: School of Conservation and Restoration)" done in 2019 at College of Fine Arts, University of Tehran, under the supervision of the second author.

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1. INTRODUCTION

Changing the function and adaptive reuse of buildings are almost as old as construction. According to society and its values, different approaches have been taken to revitalize old buildings over the centuries. In the ancient period, the land use of buildings was merely changed based on the users' functional needs. However, later on, this approach was changed, and the semantic significance of the historical-cultural heritage was considered. Since, these buildings play a vital role in conveying the cultural identity to the next generations and are the sign and symbol of the ancient period, they must be preserved and conserved as they are the evidence of the culture of life of the people who lived in the previous era. Nowadays, reusing heritage building is one of the best methods for the conservation[1] of these buildings and is one of the excellent ways to achieve sustainability. There are many cases and examples in the various countries regarding the land-use change of the heritage buildings or the allocation of the land use to the abandoned buildings that while conserving the building as a historical and cultural heritage, have met the people's needs of the region, increased the social and economic prosperity, and attracted the tourist to the region. The necessity to develop an educational space for the conservation discipline in Tehran University due to the high number of historical-cultural monuments throughout the country and the necessity to educate the experts and specialized in the conservation and preservation[2] discipline and other relevant disciplines were the reasons to implement this study and conduct the feasibility and capacity assessment of the proposed options to accept this function. In this regard, Etehadieh House, Darolfunun School, and Negarestan Museum Garden were suggested as the proposed options by the experts to be studied in terms of feasibility and capacity assessment. Experts believed that the land-use change and reuse of these buildings as the educational space could be successful and influential. After investigating the questionnaires and concluding the scores, Negarestan Museum Garden became the priority by a score of 24.9. Darolfunun School and Etehadieh House were also ranked second and third by obtaining 22.9 and 19.3, respectively. According to the surveys, the experts suggested that by combining the educational space and museum, Negarestan Museum Garden can be influential in improving the conditions of the surrounding environment while meeting the considered spatial need. Also, returning the educational land use to this complex as the main and primary land use of this building is more justifiable than any other land use and is appropriate in terms of space arrangement. Furthermore, Negarestan Garden Museum is one of the sub-set buildings of Tehran University reusing of which as Conservation School is possible to develop the educational space of conservation discipline in Tehran University. Given the history of this historical complex and its land uses in the contemporary era, it seems that this complex enjoys a high potential to readmit this function, which is also consistent with the spatial, physical, functional, and cultural features of the building. Besides, re-establishing the educational activity in this complex will be an effective approach to improve its concepts and convey them to the current and future generations that also emphasizes keeping the functional integrity, as one of the conservational principles. Regarding the land-use change, it can be stated that numerous adaptive reuse projects were not successful due to the inadequacy to the needs of the region, or the lack of building's accordance with the new land use have caused irreparable damages to the building. Also, due to the lack of a precise method to assess the conducted projects, each project is a new experience, which is implemented disregarding the strengths and weaknesses of the previous experiences to reduce the possible errors and mistakes. Therefore, the need to develop a framework to determine the effective criteria for the adaptive reuse process is further emphasized. Although many studies have been conducted on the adaptive reuse approach and its criteria and several historical monuments in different countries, including Iran, have become educational land use, studies have pointed to several effective criteria in adaptive reuse that the present paper tried to compile and categorize them comprehensively. Also, the priority and significance of these criteria were identified based on the considered function in this paper, while most previous studies considered the criteria generally and disregarding the type of function. The adaptive reuse approach has different types and finding a new function for the considered heritage building has been the main concern in most of the conducted studies. However, the current paper evaluated the proposed option and assessed its capacities and potentials based on the criteria through which its strengths and weaknesses were determined. Thus, the main questions of the research are as follows:

1. What are the capacity assessment criteria for adaptive reuse of historic buildings and their importance and preference to assign educational use to each other?
2. How are the capacities and potentials of the Negarestan Museum Garden assessed as a selected case for assigning educational use (School of Conservation)?

According to the main questions, the current research aimed to collect and introduce the influential criteria and factors in the adaptive reuse process of the historical-cultural heritage, determine their significance and priority to each other, and present a proper model for decision making considering all the influential criteria and components. The information collection method was field and library research. The information related to the criteria and their comparison and the evaluation of the capacities of Negarestan Museum Garden were implemented by distributing two questionnaires among 30 experts, specialized, and professors of conservation. Eventually, the capacities of Negarestan Museum

Garden were determined to accept the land use of the school of conservation. This method can be applied by decision-makers, policymakers, public institutions, designers, architects, owners, conservation experts, and others who play a role in selecting a proper function for the architectural heritage. Also, it is a proper method to assess the previous measures.

2. RESEARCH LITERATURE REVIEW

Adaptation includes all the activities done to change the capacity, function, or appearance of a building under conservation. For instance, any kind of intervention to moderate, reuse, improve the current status of a building into a more proper and suitable (However, by studying the examples of the adaptive reuse of the buildings, it seems that this process has been implemented in changing the function). In the following, the experts' views and the concept of adaptive reuse, as one of the conservation methods, were presented.

2.1. Adaptive Reuse Approach of Architectural Heritage

Adaptation can be used interchangeably as "up-to-dating" or "renovating". In terms, adaptation includes series of measures that, by creating appropriate conditions in the space-physical organization, cause a compromise between the body and the ancient space with today's needs (Habibi & Maghsoudi, 2013). Any work to a building over and above maintenance to change its capacity, function or performance (Douglas, 2006). Adaptive reuse is a 'rehabilitation, renovation or restoration work that does not necessarily involve a change of use' and it will 'extend the useful life and sustainability in a combination of improvement and conversion' (Bullen, 2007). Adaptive reuse is the reuse of something that often serves another purpose and is usually considered a better option than destroying or abandoning it (Jokilehto, 2006). According to Conejos, Langston, & Smith (2011), adaptive reuse is the process of modifying a building so that it can be adapted to suit different uses than intended originally.

Adaptive reuse is one of the key methods to achieve sustainability. Achieving suitability through adaptive reuse requires acquiring its various components, such as environmental, economic, cultural, and social suitability. For instance, People feel a stronger sense of connection with their local surroundings through heritage, which is quite different to the mentality associated with new building stock, in that it can be, replicated anywhere and therefore lends no specific connection to the local environment. Heritage buildings are cultural icons and their preservation impacts on community well-being, sense of place and therefore social sustainability (Bullen & Love, 2011). Establishing various activities and preventing the creation of single-functional land use in the building are among the influential factors causing the vitality and dynamicity in the historical context. It is due to creating functional diversity in the historical context can lead to more people referring to the context. Prominent heritage buildings require land uses that, along with appropriate economic returns and consistency with contemporary needs, can encourage people to refer to the historic building and context and eliminate the depression and stagnation of the context. It must be stressed that the optimal use of the buildings is often the best method to preserve them.

As previously mentioned, reusing heritage buildings leads to achieving environmental sustainability while creating economic, cultural, and social sustainability. In recent years, increasing construction in the cities, especially in large cities, has led to increasing the destruction in the buildings that still have the optimal and adequate physical life span to use. It will cause the waste to enter the environment and air pollution. Douglas (2002) mentioned that reuse is known as one of the most appropriate methods to achieve sustainability due to increasing the life span of the buildings, saving in the costs, reducing the exploitation of mines for the production of construction materials, reducing the costs of recycling materials, and burying construction waste, reducing labor costs, reducing environmental damage, etc. Nowadays, experts believe that the reuse of the current buildings to achieve sustainability is not sufficient lonely, and by considering the required measured, these buildings must be close to the green buildings in terms of energy consumption. Building adaptive reuse is an alternative to traditional demolition and reconstruction; but entails less energy and waste. Existing buildings that have been upgraded to achieve substantial cuts in green gas emissions are considered a more climate friendly strategy than producing new energy efficient buildings. (Conejos, Langston & Smith, 2011, p.1).

Rereading and analyzing the international declaration and documents indicate that the principles of adaptive reuse are a way for the conservation and achieving the sustainability studying and investigating of which are necessary to better recognition of this approach, decision making, and providing a proper performance. The international charters and conventions have often paid particular attention to the conservation of the architectural heritage and emphasized the adaptation of the new land-use assigned to these buildings to their cultural identity and application of the least and minimum changes on them. In the following, 19 substances of these conventions and agreements on reusing the heritage buildings were studied in Table 1 to use them to extract the criteria.

Table 1. Adaptive Reuse Approach in the International Documents of Conservation

Year	Agreement Name	A Brief Description of the Proposed Principles
1931	Athens Charter	- Recommending to own and live in the buildings whose conservation is guaranteed in this way.

Year	Agreement Name	A Brief Description of the Proposed Principles
1964	Venice Charter	- Conservation of heritage buildings by reusing them for useful purposes
		- No change in the order, arrangement or decorations of the building and retaining the proportions of mass and color of the building in interventions
1972	Budapest Declaration	- Recommending the reuse of heritage buildings with new functions by preserving the structure and character of the building.
1975	European Charter of Architectural Heritage	- Integrated conservation as a joint result of "the application of sensitive restoration techniques and the correct choice of appropriate functions"
1983	Appleton Charter, Canada	- Retaining the original function of the building, if possible, otherwise, choosing a land use compatible with minimal change and respect for the original and traditional patterns.
		- Reflecting the contemporary ideas in case of using new materials to provide the requirements of the new land use while appreciating and reinforcing the original spirit and meaning of the building.
		- Recognizability of the new land use with an educated view and preserving the total integration and continuity of the building.
		-Using the reversible processes.
		- Preserving the structural and technical integration of the building.
1985	Granada Convention, Spain	- Observing the conservation principles while meeting today's needs and preparing the old buildings to accept the new function.
1987	Charter for the Conservation of Historic Towns (ICOMOS), Washington	- Adaptation and compatibility of the new land use and activities with the features and characteristics of the historic cities and regions.
		- Adaptation and compatibility of historical areas to contemporary life by creating appropriate facilities or improving public service facilities
1987	Declaration of Scared Art of Central Committee of Italy.	- Ensuring the maintenance and durability of the building through allocating a practical purpose.
		- Lack of contradiction of new land use with the features and meaning of the building
1992	New Zealand Charter	- Facilitating the conservation of the cultural heritage through their economic, cultural, and social service with a useful purpose.
		- Implementation adaptation if it is necessary to continue using the building.
1992	Charter for the Conservation of Historic Towns	- Adaptation and compatibility of the new uses and functions with the total features and characteristics of the historical place.
1999	Mexico City Declaration	- Reuse the vernacular structure by respecting the integration, character, and appearance of the building.
		- Providing acceptable life standards in case of reusing the building.
2000	Charter of Krakow	- The purpose of conserving historic buildings and monuments is to maintain originality and integration.
		- To achieve conservation, in many cases, compatible land use with the existing space and concepts is also required.
2002	Society for The Protection of Ancient Buildings Declaration	- The effect of the creative adaptation in improving the historical value of an ancient building.
		- Providing a list to present better options in changing the land use for owners and their consultants.
2003	ICOMOS Charter, Victoria Falls, Zimbabwe	- Preserving the safety of the building in case of changes in its function and land use.
2008	The Operational Guidelines for the Implementation of the World Heritage Convention	- Supporting the features and characteristics of the world heritage through various and continuous sustainable uses
		- The lack of creating an adverse effect on the global values, integration, and originality of the historical monuments through reusing.
2010	Charter of New Zealand	- Facilitating the preservation of the heritage buildings by using them.
		- Preserving the main land use of the building if possible, and in case of changing, the lack of contradiction of the new land use with the historical and cultural value of the building.
		- The least intervention and their reversibility

Year	Agreement Name	A Brief Description of the Proposed Principles
		- In a new use, any alterations or additions must be consistent with the original form and layout of the site, and inappropriate or inconsistent discrepancies in shape, scale, mass, color, and materials must be avoided.
2011	Paris Agreement	- Adaptation of the new land-use assigned to the heritage buildings and providing the modern living standards in them.
2013	Burra Charter	- Reuse of the heritage building as a form of conservation.
		- If the land use of the building enjoys cultural significance, it must be preserved.
		- Preserving the context of the building and lack of conservation, destruction, illegal intervention, and changes that have adverse effects on the building.
		- Reversibility of the changes.
		- Adaptation must be associated with the minimum change while preserving the physical value and cultural identity of the place.
		- Recognizable interventions.
		- Resecting the significance of the attachment of the people and the place.
2017	The Operational Guidelines for the Implementation of the World Heritage Convention	- Supporting various and constant use that contribute to the quality of life of the communities.
		- Sustainable use or any change that does not have an adverse effect on the prominent global values, integration, or authenticity.
		- Reuse of the global heritage must be sustainable in terms of culture and environment.

(Tootoonchi, 2019)

Many Iranian and foreign experts and thinkers studied the influential factors in the adaptive reuse process and classified them in their studies. For example, Bullen and Love (2011) suggested the following as influential criteria: the historical significance, the effect in achieving the sustainable criteria, building dimensions, type of the building, flexibility and technical capacity of the building for adaptation, local community, the stakeholders' opinions, the effect in the local economy, and the building orientation considering the climate. Shehata, Moustafa, and Sherif (2014) recommended the following criteria in evaluating the adaptive reuse projects: preserving the character, authenticity, and identity of the building, explicitness of alterations, the safety and structural stability, compatibility between building and new function, accessibility, economic and intangible benefits and minimum adaptation costs of the project, improving the local community conditions, enhancement of the social and cultural values, increasing people's awareness, increase the liveability of historic quarters. Also, Conejos, Langston, and Smith (2014), while introducing similar criteria in their research, suggested the influential criteria in the adaptive reuse process as follows: the broadness and extent of the site, stability and durability of the materials, ability to make changes in the building, the appropriateness of the number of plots and buildings available on the site, the orientation of the building compatible with the climate, the existence of urban infrastructure and up-to-date facilities and equipment in the building, having a building management system, the necessary infrastructure for the vehicle and pedestrian movement, security in the region and the standards of the physical environment, and conservation of the building as a cultural heritage. In the following, in this regard, Islami et al. stated: "the new function should not damage the main form of the building and prevent visiting all parts of the building by the visitors. Reusing should not be interfered with tourists' understanding of the buildings' main function (Islami, Dehghan, & Naeimi, 2016), and new function and reuse must be relevant to the context of the monument and urban environment and cause the vitality to the surrounding environment of the monument.

Furthermore, Mohamed and Alauddin (2016) pointed to the criteria, such as safety and structural stability, preserving the authenticity and cultural identity of the building and region by establishing a new land use, contributing to the environmental sustainability, site location, and ease of access to that, and the appropriation of the new function. While suggesting the previous criteria, such as preservation of various components of integration, such as structural-spatial, structural-historical, and visual-aesthetic integrity of the building and the surrounding environment after assigning a new function, Chen, Chiu, and Tsai (2018) also introduced the following criteria in their research: Increasing the prosperity of the local economy and attracting capital to the region and reviving and strengthening traditional businesses, increasing the functional life of the building, increasing the sense of solidarity and social cohesion among the people, increasing social benefits and facilities and reducing natural environment change by the use of existing buildings.

Revitalization and Utilization Fund for Historic Places also introduced regulations in 2012 to revitalize and reuse heritage buildings that are very similar to the stated criteria. However, economic justification of the

project, the proportionate of the surrounding functions of the building to the new land use, and the possibility of realization of the project legally are among these criteria.

In the following, based on the review and analysis of theories, documents, international agreements, criteria affecting the evaluation and capacity assessment of valuable buildings for adaptive reuse were classified and presented in Table 2.

Table 2. Evaluation Criteria for Reuse of Heritage Buildings

Criterion	Sub-criterion
Physical and Environmental	- Extent and broadness of the site (Conejos, Langston, & Smith, 2014)
	- The proportion of dimensions and size of the building with the new function (Author by case studies)
	- Safety and structural stability (Noorzalifah & Alauddin, 2016; Iravani, 2012)
	- Stability and durability of materials (Conejos, Langston, & Smith, 2014) and the ability to use existing materials (Bullen & Love, 2011)
	- Ability to make changes to assign a new function (modularity of the plan, free spaces to adapt to the new function and the ability to change one part without damaging other parts, dry connections in the building to join new columns, walls, ceilings, and floors) (Sadafi, Zain, & Jamil, 2012; Conejos, Langston, & Smith, 2014; Bullen & Love, 2011)
	- Retaining and strengthening the structural-spatial integrity of the surrounding environment and neighborhood by assigning new function (Chen, Chiu, & Tsai, 2018)
	- Preserving the structural-historical and visual-aesthetic integrity of the building (Conejos, Langston, & Smith, 2014; Chen, Chiu, & Tsai, 2018)
	- Extending the life and physical life of the building by assigning a new function (Bullen & Love, 2011)
	- Contributing to retaining the originality of the building or assigning a new use (retaining the originality of the plan, materials, construction technique, and context) (Conejos, Langston, & Smith, 2014; Noorzalifah & Alauddin, 2016)
	- Contributing to environmental sustainability (Nootzalifah & Aluaddin, 2016; Bullen & Love, 2011)
	- Site location in the region and easy access to it (Conejos, Langston, & Smith, 2014; Noorzalifah & Aluaddin, 2016)
	- Ability to create new extensions and spatial expansion to accept the required uses (Author by studying case studies)
Economic	- Improving and enhancing the local economic prosperity, attracting capital and financial resources to the region (Chen, Chiu, & Tsai, 2018), attracting the population to the region to create economic vitality (Conejos, Langston, & Smith; Bullen & Love, 2010)
	- Revitalizing and improving traditional business and local industries (Chen, Chiu, & Tsai, 2018; Shehata, Moustafa, & Sherif, 2014)
	- Creating new employment opportunities through assigning new use to the building (Author by studying the case studies)
	- Ability to attract the required initial capital to implement the project and monetarizing after that to provide the required costs for maintenance (Chen, Chiu, & Tsai, 2018; Nootzalifah & Aluaddin, 2016), and economic sustainability after reuse (Bullen & Love, 2011)
	- Cost efficiency in terms of the required costs for maintenance, conservation, and change of the building use and maintenance after that (Author) and the economic justification of the project (Iravani, 2012)
Functional	- The adaptability of the new land use with the original use of the building, preserving the evolution course and functional integrity of the building (Douglas, 2002; Latham, 2000; Cantacuzino, 1975; Jokilehto, 2007)
	- Appropriateness of the number of plots and structures available on the site to accept related functions (Conejos, Langston, & Smith, 2014)
	- The location of the building in the city and the appropriateness of the functions around the building with the new use (Conejos, Langston, & Smith, 2014; Iravani, 2012)
	- Matching the needs of the region with new performance and meeting the needs of local people (Noorzalifah & Alauddin, 2016; Douglas, 2002)
	- Increasing functional life and restoring urban life through new use (Chen, Chiu, & Tsai, 2018; Bullen & Love, 2011)
	- Possibility of tourists visiting the building after being given a new function (Pinto et al., 2017; Dehghan et al., 2016)

Criterion	Sub-criterion
Technical (Facilities and Equipment)	- Orientation of building that provides natural light, ventilation, heating, cooling, etc. (Chen, Chiu, & Tsai, 2018; Conejos, Langston, & Smith, 2014; Bullen & Love, 2011).
	- Existence of urban equipment and infrastructure (electricity, sewage, energy distribution, etc.) (Author by studying case studies)
	- Existence of ducts, canals, and installation equipment (electricity, telephone, sewage, heating, and cooling, etc.) in the building (Conejos, Langston, & Smith, 2014)
	- Building acoustics against noise (Conejos, Langston, & Smith, 2014)
	- Having a building management system (automatic control and monitoring system for mechanical and electrical equipment inside the building) (Conejos, Langston, & Smith, 2014)
	- Existence of equipment standards in the reuse process to ensure the comfort and convenience of users when using the building (Conejos, Langston, & Smith, 2014)
	- Existence of necessary infrastructures for transportation and movement of the vehicle and pedestrian (Conejos, Langston, & Smith, 2014)
Social-cultural	- Preserving the historical values of the building (Chen, Chiu, & Tsai, 2018; Conejos, Langston, & Smith, 2014)
	- Preserving the cultural identity of the building while assigning a new function to the building (Conejos, Langston & Smith, 2014)
	- Preserving the cultural identity of the region and the sense of place (Chen, Chiu, & Tsai, 2018; Conejos, Langston, & Smith, 2014; Noorzalifah & Alauddin, 2016), preserving the intangible dimensions of originality, showing cultural values or indigenous characteristics (art, architecture, Construction technique, etc.) on behalf of that particular region (Chen, Chiu & Tsai, 2018) and cultural sustainability (Wang & Zeng, 2010)
	- Creating a positive social impact by new performance on the region (Bullen & Love, 2011)
	- Increasing the sense of solidarity and social cohesion among people (Chen, Chiu, & Tsai, 2018) and social sustainability (English Heritage, 2008; Bullen & Love, 2011)
	- Increasing social benefits and reinforcing existing facilities in the region (Chen, Chiu, & Tsai, 2018)
	- Raising public awareness and collective participation (Chen, Chiu, & Tsai, 2018; Conejos, Langston, Smith, 2014; Bullen & Love, 2011)
	- Increasing and enhancing building values after assigning new function (Bullen & Love, 2011)
	- Existence of security in the area for new users (Keyvanfar, Shafaghat, Muhammad, & Ferwati, 2018; Conejos, Langston, & Smith, 2014)
Regulations and Rules	- Existence of fire extinguishing system and fire protection (Conejos, Langston, & Smith, 2014
	- Existence of physical environment standards in the vicinity of the building (Conejos, Langston, & Smith, 2014)
	- Accessibility for people with disabilities (Conejos, Langston, & Smith, 2014)
	- Existence of efficiency and optimization of energy consumption standards in the building (Bullen & Love, 2011)
	- The position of the building in the upstream plans and the rules and regulations intended for it (Conejos, Langston, & Smith, 2014)
Legal	- Ability to restore the building to its original state after land-use change (Pinto et al., 2017)
	- No adverse environmental impact after assigning new function (Conejos, Langston, & Smith, 2014)
	- Using existing buildings and thus reducing human control over the natural environment and its change (Chen, Chiu, & Tsai, 2018)
	- Legal issues related to ownership and neighborhood of the building and the absence of problems in this area (Conejos, Langston, & Smith, 2014) and the possibility of realizing the plan from a legal perspective (Iravani, 2012)
	- Preservation of the building as a cultural and historical heritage by assigning a new use (Conejos, Langston, & Smith, 2014)
	- Reducing the use of natural resources and managing pollution and waste by assigning new function (Chen, Chiu, & Tsai, 2018; Keyvanfar, Shafaghat, Muhammad, & Ferwati, 2018; Bullen & Love, 2010)

(Tootoonchi, 2019)

3. RESEARCH METHODOLOGY

The current research was a fundamental-applied study based on the mixed research approach. The information collection method was field and library research in the qualitative part. Also, two questionnaires (one questionnaire to prioritize the criteria, and the second questionnaire to assess the case study) and an interview were used in the quantitative part of the study. Generally, this research was conducted using Multi-Criteria Decision Making Method (MCDM) and Analytic Hierarchy Process (AHP). First, the influential criteria and factors in the adaptive reuse approach were determined by conceptual literature review and the experts and elites' opinions. In the second step, the experts ranked sub-criteria to identify their significance to each other. 30 experts and specialists in conversation were surveyed by a questionnaire to compare and evaluate the sub-criteria. The experts ranked sub-criteria to weight and assess these sub-criteria using the pairwise comparison and the Five-point Likert Scale. Eventually, by entering these scores in Super Decision software, the weight and priority of these sub-criteria to other sub-criteria were determined. According to the consultations with the management and conservation experts and the type of the problem, the weight of the criteria was considered equal in this research, and the sub-criteria were given different values.

Assessing the proposed options was also done based on the introduced criteria and using the second questionnaire. Eventually, the obtained scores in the second questionnaire were multiplied by the weight and value of the sub-criteria, and the final score of the buildings was obtained out of 35. The higher the final score of the building, the more opportunities there are for the adaptive reuse project, and the more suitable it will be to accept the proposed function (School of Conservation).

4. INTRODUCTION OF CASE STUDY

Negarestan Museum Garden was built in 1809 and was outside the city of Tehran at the time of construction. Fath Ali Shah Qajar showed a special interest in this garden and often spent some time in this garden in summer. This building was built in the style of a pavilion and had two mansions called Delgosha and Qalamadan Hall. In 1868, when Nasser al-Din Shah expanded the city of Tehran, this building was placed inside a new fence and given to government institutions. Over time, since this garden was no longer part of the royal buildings, it was destroyed. Until 1929, the Ministry of Education demolished most of the buildings of Fath Ali Shah era and built three large buildings in this place, which were dedicated to the Danesh Sara-Ye Ali. Russian immigrant architect and engineer Nikolai Markov helped in this regard. In later periods, this complex was the location of the classes of the Faculty of Literature of the University of Tehran. Until after the construction of the current buildings of the University of Tehran, the classes were moved there, and until recent decades, this complex was used for various other cultural and research uses. The main building of this garden is used as a museum today. The library building is located in the northeast, the office building in the north, the greenhouse in the northwest, the cafe-restaurant, facilities and storage in the west, and the prayer hall in the east of the garden.

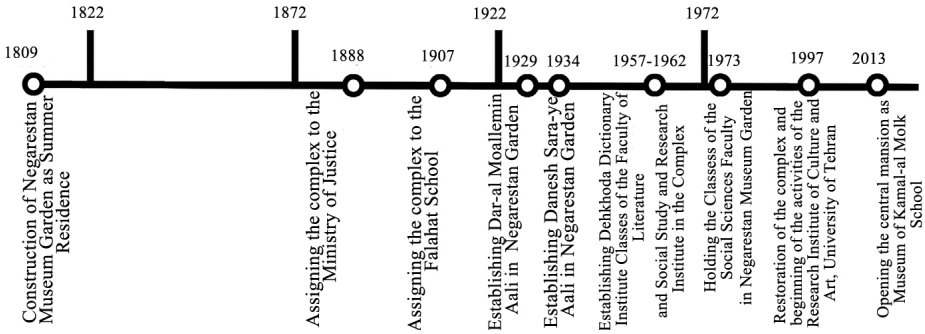
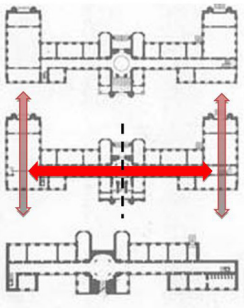
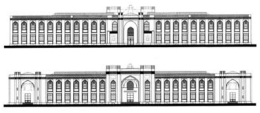
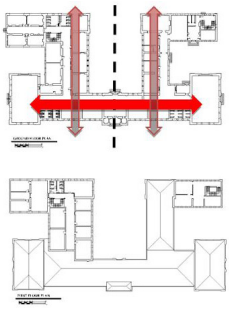
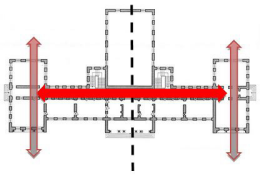


Fig. 1. Trajectory of Land Use Change in Negarestan Museum Garden

The plan of the central mansion of the Negarestan Garden is very much similar to the plan of Alborz High School and Anoushiarvan Dadgar High school. All three buildings were designed by Nikolai Markov for educational purposes. This plan consists of the symmetric plan and a horizontal corridor, leading to the lateral sides at the end of the two right and left sides. These three buildings presented an architectural style of the Pahlavi era, called the Traditionalist School. Traditionalist architecture has prominent traditional plan or symbols. However, modern materials and technology are generally or partially used to implement it. The ogee arches, muqarnas capitals, tile work decorated with arabesque motifs, and string course are among the elements of the traditional architecture used in this building (Ghobadian, 2013).

Table 3. Comparison of the Architectures of the Central Mansion of Negarestan Garden and Other Two Buildings All of Which Were Designed and Built for Educational Function By Nikolai Markov

Building Name	Introduction	Plan	Façade
Alborz High School (1926)	The elongated volume of the building has full symmetry, which leads to two turned wings at both ends, and the entrance is located in the center of its symmetry. Repetition of windows and openings on both sides ends in turned wings The entrance is a porch imitating the architecture of the Islamic period, which has a symmetrical composition with the two semi-towers on both sides.		
Dar-al Moallemin Ali (Central Mansion of the Negarestan garden (1929)	The composition of the building with an elongated volume and with inverted wings and its placement in relation to the axial of the yard has used classical geometric features. The recurring element in the south façade has a combination of three windows and two columns that are repeated three times along each wing and end in a projecting part that has a façade with three windows.		
Anoushiravan Dadgar High School (1937)	The formation of the building is based on a longitudinal axis in the east and west direction with a length of about 76 meters and two north-south arms on both sides of the building emphasizes the stability and statistics of the building.		

5. FINDINGS OBTAINED FROM QUESTIONNAIRES

As mentioned in the methodology section of the research, the sub-criteria were weighted and compared in pairs. Also, their priority and significance to each other were determined through distributing the first questionnaire among 30 experts and specialists of conservation and using Analytic Hierarchy Process (AHP) and Super Decision Software. Then, the second questionnaire was presented to the experts to assess and score the proposed options based on the stated criteria to accept the educational function of the School of Conservation. In the last step, the mean score obtained by these buildings in each sub-criterion was multiplied by their weight and significance and the total of these values show their final score out of 35. Table (4) presents the obtained scores of the selected case, i.e., Negarestan Museum Garden, which was proposed with a score of approximately 25 as the most appropriate place for the school of conservation according to the experts' opinion.

Table 4. The Weight of the Sub-Criteria and the Score of the Negarestan Museum Garden in Each Part to Give the Educational Land Use (School of Conservation)

Criterion	Total Weight	Sub-criterion	Weight of Sub-criterion	Building Score Out of 5
Physical and Environment	1	- The extent and broadness of the site	0.01247	4.8
		- The proportion of dimensions and size of the building with the new function	0.04728	5
		- Safety and structural stability	0.12359	3.75
		- Stability and durability of materials and the ability to use existing materials	0.06239	4.25
		- Ability to make changes to assign new function (modularity of the plan, free spaces to adapt to the new function and the ability to change one part without damaging other parts, dry connections in the building to join new columns, walls, ceilings, and floors)	0.08337	4.2.
		- Improving the structural-spatial integrity of the surrounding environment and vicinity of the building by assigning new function	0.0886	4.25

Criterion	Total Weight	Sub-criterion	Weight of Sub-criterion	Building Score Out of 5
		- Retaining the structural-historical and visual-aesthetic integrity of the building	0.10701	4.6
		- Increasing the life and physical life of the building by assigning new function	0.14898	4.4
		- Contributing to retaining the originality of the building by assigning a new use (retaining the originality of the plan, materials, construction technique, and context)	0.12127	3.8
		- contributing to the environmental sustainability	0.11185	3.75
		- Location of the site in the area and ease of access to it	0.2703	4.5
		- Ability to create new extensions and expand the space to accept the necessary uses	0.06617	1.5
Economic	1	- Improving and increasing the prosperity of the local economy, attracting capital and financial resources to the region, attracting the population to the region to create economic vitality	0.4630	2.5
		- Revitalizing and strengthening traditional jobs and indigenous industries	0.04866	1
		- Creating new job opportunities by assigning new use to the building	0.11857	3
		- Ability to attract the initial capital required to carry out the project and generate revenue afterward to provide the necessary costs for maintenance and economic stability of the building after reuse	0.23235	3
		- Economic cost-effectiveness in terms of cost for the repair, restoration, change of building function, and subsequent maintenance and economic justification of the project	0.13741	3.65
Functional	1	- Adaptation of the new function to the main function of the building, retaining the evolution and functional integrity of the building	0.182190	4.5
		- The proper number of plots and buildings available on the site to accept related functions	0.07526	4.8
		- The location of the building in the city and the appropriateness of the functions around the building with the new use	0.22595	4.25
		- Matching the needs of the region with new function and meeting the needs of local people	0.10553	3
		- Increasing the functional life and returning the urban life through a new function	0.36237	3.25
		- Possibility of visiting the building by tourists after assigning a new function	0.04871	3.75
Technical (Facilities and Equipment)	1	- Climate-oriented building that provides the possibility of natural light, ventilation, heating, cooling, etc.	0.03646	4
		- Existence of urban equipment and infrastructure (electricity, sewage, energy distribution, etc.)	0.26423	4.6.
		- Existence of ducts, canals, and installation equipment (electricity, telephone, sewage, heating, and cooling, etc.) in the building	0.19995	4.5.
		- The acoustics of the building against noise	0.04512	3
		- Having a building management system (automatic control and monitoring system for mechanical and electrical equipment inside the building)	0.09512	3

Criterion	Total Weight	Sub-criterion	Weight of Sub-criterion	Building Score Out of 5
		- Existence of equipment standards in the reuse process to ensure the comfort and convenience of users when using the building	0.11235	3.5
		- Existence of necessary infrastructures for transportation and movement of the vehicle and pedestrian	0.24676	3.75
Cultural-social	1	- Retaining historical values of the building	0.09321	4
		- Retaining the cultural identity of the building while assigning a new function	0.19676	4
		- Retaining the cultural identity of the region and sense of a place, retaining the intangible aspects of authenticity, indicating the cultural values or vernacular indicators (art, architecture, construction technique, etc.) as the representative of that region and cultural sustainability.	0.14382	3.75
		- Creating a positive social impact by new function on the region	0.04598	3.5
		- Increasing the sense of solidarity and social cohesion among people and social sustainability	0.03956	3
		- Increasing social benefits and strengthening existing facilities in the region	0.05666	3.5
		- Increasing public awareness and collective participation	0.06637	3.6
		- Increasing and improving the values of the building after assigning a new function	0.15492	4.5
		- Existence of security in the region for new users	0.20272	4.25
Regulations and Rules	1	- Existence of fire extinguishing system and fire protection	0.06403	1.75
		- Existence of physical environment standards in the vicinity of the building	0.23313	3.3
		- Access of people with disabilities	0.18811	2.3
		- Existence of efficiency and optimization of energy consumption standards in the building	0.26018	1.6
		- The location of the building in the upstream plans and the rules and regulations intended for it	0.25454	4
Legal	1	- Ability to restore the building to its original state after changing the function	0.25626	4
		- Not creating adverse environmental impact after assigning a new function	0.06436	2.75
		- Using existing buildings and as a result, reducing human domination over the natural environment and its change	0.11035	4.3
		- Legal issues related to the ownership and vicinity of the building and the absence of problems in this regard and the possibility of realizing the project from a legal perspective	0.0981	2.6
		- Preserving the building as a cultural and historical heritage by assigning a new function	0.3503	4
		- Reducing the use of natural resources and managing pollution and waste by assigning new function	0.12063	3.5
Total	1	Total	7	24.9586 Out of 35

Generally, according to Table 3 and the questionnaire that was given to the experts to assess the Negarestan Museum Garden based on the stated criteria to evaluate its potentials and capacities to accept the educational land use (School of Conservation), the results are as follows. Besides, its strengths and weaknesses in case of deciding to change the land use are determined.

Based on the scores given by the experts to the Negarestan Museum Garden, the following sub-criteria of the environmental-physical criterion obtained the highest scores through assigning a new function, respectively: the proportion of dimensions and size of the building with the new function, the extent of the site, retaining the structural-historical and visual-aesthetic integrity of the building, ease of access to the complex, and increasing the life and physical life of the building. All the values are close to 5 which is a full score. This criterion obtained a score higher than 3.5 in other sub-criteria, which is relatively acceptable. This criterion obtained a score of 1.5 in the sub-criteria of "the ability to create new additions and spatial expansion". Indeed, given the number of buildings in the garden and its extent, no new extensions or construction of a new building will probably be required. Investigating the scores obtained in the economic criteria shows that the Negarestan Museum Garden has an upward medium capacity to attract initial capital and generate revenue after the implementation of the project and also to create economic prosperity in the region after the change of use. Also, in terms of economic efficiency, the implementation of the project has received the highest score of nearly four. However, according to experts, the revitalization and empowerment of local and traditional jobs will not change much by turning the Negarestan Museum Garden into a School. Therefore, they have considered a score of 1 for it. From the point of view of functional criteria, experts have considered the compatibility of the new function with the main function of the building, which was educational, and the number of plots on the site and ease of access to it proper. They believe that assigning this function will link the complex with urban life. They also considered a medium score of 3 in terms of matching the needs of the region with the proposed land use. In terms of technical criteria and facilities and equipment, since this complex was recently repaired and its facilities were updated, they obtained fair scores in most sub-criteria (above 3.5). Only in the sub-criteria of having an automatic system for controlling mechanical and electrical equipment inside the building and being acoustic against noise, it received a score of three, which, if necessary, can be considered in the adaptive reuse plan to improve these conditions. In the sub-criteria of socio-cultural criteria, experts have considered good scores (above 3.5) for it. They believe that using this complex as a school can preserve its historical values and cultural identity and have positive socio-cultural effects on its environment. The lowest score of this section has been three, which experts have considered for the effect of the change of use on strengthening the sense of solidarity and social cohesion among people. Similar to many Iranian and foreign experiences in this area, this component can be further improved after the change of use by holding ceremonies and various gatherings on different occasions and increasing the participation of people in this complex. Moreover, studying the scores given by the experts indicated that in terms of the sub-criteria of regulations and rules, this complex has only obtained a good score in the upstream plans as the proposed land use is in line with the terms considered intended for it in the detailed plans. However, in other sub-criteria, i.e., the standards of the physical environment in the vicinity of the building, the access of the disabled, the fire extinguishing system, and finally the existence of energy efficiency standards with a score of 1.6, respectively, it has obtained average downward scores. Thus, it should be addressed in the adaptive reuse project, and necessary measures must be taken to improve the current situation.

Eventually, regarding the legal sub-criteria, the experts considered relatively fair scores for this building. According to the given answers, the use of this complex as a school can preserve it as a historical and cultural heritage. Based on Table 4, this section obtained the highest score. On the other hand, the minimum score of 2.7 was given to the sub-criterion of "not creating adverse effects on the environment after assigning a new function", which is a medium score. This complex obtained a total score of 25 out of 35. It is considered an acceptable score in different sections and, considering their significance and value to each other. This building has obtained 70% of the total score. In its adaptive reuse project and change of land use to the school, more desirable conditions can be created by improving the strengths and resolving the weaknesses recognized based on the scores. Also, while assigning dynamic land use, by more connection to the city and increasing the economic prosperity and improving the social conditions of the region, its conservation can happen as one of the complexes with the cultural and historical value of the city and meet its spatial need to assign a new land use to it.

6. CONCLUSION

As previously mentioned, although the reuse of the buildings has been implemented constantly everywhere and in different ways, this concept enjoys a greater sensitivity nowadays and requires a framework and method to avoid the bias and become more scientific to reduce making mistakes and damaging the irreparable damages to the building and losing time and cost. While collecting information and summarizing the capacity assessment criteria of the reuse of the buildings and determining their value in case of assigning a specific land use (educational), the current research attempted to develop a scientific and

comprehensive method for decision making regarding the new land use to the heritage buildings, indicating that which factors are determinant in the capacity assessment and evaluation of the buildings to accept new functions. Through these criteria, the strengths and weaknesses of the building can be recognized so that they could be further improved or resolved. The significant point is considering all the influential factors in the decision-making process of the adaptive reuse to meet today's spatial needs while preserving the building and revitalizing it in the contemporary era. As stated in the previous section, the criteria were collected comprehensively and introduced as 7 main criteria of environmental-physical, economic, social-cultural, functional, legal, and regulations, and 50 sub-criteria were suggested. Also, the different values of the sub-criteria were determined to reuse the building as an educational place. Also, they were applied in the experts' evaluation of the proposed buildings. Finally, Negarestan Museum Garden was selected as the most proper option with the highest score, compared to the two other valuable buildings, i.e., Darolfunun School and Etehadieh House. Also, the strengths and weaknesses of the complex to accept the new function were determined. Its capacity was considered desirable to accept a new function in the mixture of the previous land use, i.e., museum.

END NOTE

1. Conservation: It means the process of preserving a place to secure its cultural values and uses the methods and measures, such as preservation, revitalization, change of land use, and adaptive reuse, etc., or a mix of these methods to retain the historical and cultural heritage based on the semantic significance of the heritage (total of tangible and intangible values). In the recent literature, conservation is a dynamic concept that uses preservation and development simultaneously, and the adaptive reuse approach and change of land use has been considered in the conservation of the architectural heritage. The late literature of the conservation also includes the management of change so that it supports the semantic significance, i.e., heritage values, and modifies and determines the changes in the development measures based on the semantic significance and heritage values.
2. Preservation: It means taking care of a valuable place in the current conditions, keeping it safe from damages and injuries, ongoing support, and, where necessary, stabilizing the existing structure.

REFERENCES

- Brooker, G., & Stone, S. (2004). Re-Readings: Interior Architecture and the Design Principles of Remodelling Existing Buildings. London: RIBA Enterprises Publication.
- Bullen, P. (2007). Adaptive Reuse and Sustainability of Commercial Buildings. *Facilities*, 25(2), 20-31. https://www.researchgate.net/publication/235264539
- Bullen, P., & Love, P. (2010). The Rhetoric of Adaptive Reuse or Reality of Demolition: Views from the Field, *Cities*, 27, 215-224.
- Bullen, P., & Love, P. (2011). Adaptive Reuse of Heritage Buildings. *Structural Survey*, 29(5), 411-421. https://www.researchgate.net/publication/235274709
- Bullen, P., & Love, P. (2011). Factors Influencing the Adaptive Re-Use of Buildings. *Journal of Engineering, Design and Technology*, 9, 32-46.
- Cantacuzino, S. (1975). New Uses for Old Buildings, London: Architectural press.
- Chen, Ch., Chiu, Y., & Tsai, L. (2018). Evaluating the Adaptive Reuse of Historic Buildings through Multicriteria Decision-Making. *Habitat International*, 81, 12-23. https://doi.org/10.1016/j.habitatint.2018.09.003
- Conejos, Sh., Langston, C., & Smith, J. (2011). Improving the Implementation of Adaptive Reuse Strategies for Historic Buildings. *Safeguard of Architectural, Visual, Environmental Heritage*. 6(9). http://epublications.bond.edu.au/sustainable_development/52
- Conejos, Sh., Langston, C., & Smith, J. (2014). Designing for Better Building Adaptability: A Comparison of Adaptstar and ARP Models. *Habitat International*, 41, 85-91. https://doi.org/10.1016/j.habitatint.2013.07.002
- Douglas, J. (2002). Building Adaptation, London: Butterworth-Heinemann Publishing.
- Douglas, J. (2006), Building Adaptation, Oxford: Butterworth-Heinemann Publishing.
- Ghobadian, V.)2013(. Styles & Concepts in Iranian Contemporary Architecture. Tehran: Elme memar Publication.
- Habibi, S.M., & Maghsoudi, M. (2013). Urban Renovation, International Definitions, Theories, Experiences, Charters & Declarations, Urban Methods and Operations. Tehran: University of Tehran Publication.
- Iravani, E. (2012). Three Colours of Revitalization. Tehran: Revitalization & Utilization Fund for Historical Places Publication.
- Islami, S.Gh., Dehghan, D., & Sadeghi Naeini, H. (2016). A Model Development to Adaptive Reuse of Iranian Qajar Houses: An Approach to Sociocultural Concept (A Case: Nasir Al-Din Mirza House). *American Journal of Civil Engineering and Architecture*, 4(3), 84-89. doi: 10.12691/ajcea-4-3-3
- Jokilehto, J (2007). International Charters on Urban Conservation: Some Thoughts on the Principles Expressed in Current International Doctrine. *City & Time*, 3(3), 23-42 http://www.ct.ceci-br.org
- Jokilehto, J. (2006). Considerations on Authenticity and Integrity in World Heritage Context. *City & Time*, 2(1), 1-16. URL:http://www.ct.ceci-br.org
- Keyvanfar, A., Shafaghat, A., Muhammad, N.Z., Ferwati, M.S. (2018). Driving Behaviour and Sustainable Mobility-Policies and Approaches Revisited. *Sustainability*, 10(4), 1152. https://doi.org/10.3390/su10041152
- Noorzalifah, M., & Alauddin, K. (2016). The Criteria for Decision Making in Adaptive Reuse towards Sustainable Development. The 4th International Building Control Conference, 6. https://doi.org/10.1051/matecconf/20166600092
- Pinto, M.R., De Medici, S., Senia, C., Fabbricatti, K., & De Toro, P. (2017). Building Reuse: Multi-Criteria Assessment for Compatible Design. *International Journal of Design Sciences and Technology*, 22 (2), 165-193.
- Sadafi. N., Zain, M.F.M., & Jamil, M. (2012). Assessment of Industrial and Adaptable Building Components for a Residential Layout. *International Journal of the Physical Sciences*, 7(2), 338-348. http://www.academicjournals.org/IJPS
- Shehata, W.T.A., Moustafa, Y., & Sherif, L. (2014). Towards the Comprehensive and Systematic Assessment of the Adaptive Reuse of Islamic Architectural Heritage in Cairo, a Conceptual Framework. *Journal of Cultural Heritage Management and Sustainable Development*, 5(1), 14-29. http://www.emeraldinsight.com/2044-1266.htm
- Tootoonchi, R. (2019). Adaptive Reuse Criteria Measurement of Heritage Buildings, Master Degree Thesis, Faculty of Art and Architercrue, University of Tehran.
- Wang, H.J., & Zeng, Z.T. (2010). A Multi-Objective Decision-Making Process for Reuse Selection of Historic Buildings. *Expert Systems with Applications*, 37(2), 1241-1249.

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