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An AHP-Based Multi-Criteria Model for Adaptive Reuse of Heritage Buildings

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Abstract

Reusing heritage buildings requires solving complex decision-making problems. Many challenges of reusing heritage buildings can be modeled by the multi-criteria decision-making (MCDM) method. In this study, the Analytical Hierarchy Process (AHP) method which is one of the most commonly used MCDM methods was employed to optimize the assessment process of heritage building reuse that was examined in Aksaray, Turkey. A decision-making model was established by using a literature review. By the way, the priority order of the reuse alternatives of the heritage buildings was defined by an Analytical Hierarchy Process. Therefore, changes in factors of building features (design quality, number of rooms, building quality, garden plots, landscape), accessibility (accessibility of the main road; traditional city center; health care; tourism destination; cultural heritage), environmental value (commercial services, recreation, socialization, health care facilities, urban aesthetics) directly influenced the priority order of the historic building reuse alternatives. The results revealed that the most suitable reuse alternative of the heritage buildings was for community activity centers, museums, galleries, and boutique hotels. Adaptive reuse of heritage buildings should be provided through sustainable urban planning to adapt to potential changes in the built environment. This study can play a significant role in ensuring sustainable urban planning for the adaptive reuse of heritage buildings and also in guiding decision-makers.

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1. Introduction

Adaptive reuse can be defined as giving a new function by preserving the structural features of buildings that lost their original function over time (Ahunbay, 2011; Işık, 2021). Reusing buildings has been applied worldwide in many areas, including government buildings, industrial buildings, offices, schools and religious buildings (Langston et al., 2008). Adaptive reuse of heritage buildings requires a comprehensive evaluation process as Multi Criteria Decision Making (MCDM) problems (Chen et al., 2018; Yau, 2009). In recent years, the reuse of heritage buildings and decision-making process has become increasingly important. In this process, environmental and social structure of the historic buildings should be taken into consideration as well as the economic value. The MCDM method has been used in historical buildings and reuse as well as in many different areas (Chen et al., 2018; Ferretti et al., 2014; Kutut et al., 2014). The AHP method has been widely applied in the process of policy-making, including the reuse of historic buildings (Ferretti et al., 2014). In this study, it is aimed to evaluate alternatives in the reuse of historical buildings. In the study, a decision-making model has been created to evaluate alternatives in the reuse of historical buildings in Aksaray case. Also, one of the aims of this study is to regulate the evaluation procedure of reuse alternatives.

Aksaray has a fast urbanization and transformation process since it promoted to province in 1989. However, the rapid growth in city resulted in problems as infrastructure, environment and urbanization. By 2000, rural areas were incorporated into city boundaries. Increasing housing demand and changing reality real estate values have led to

the transformation of one-story houses with gardens into apartment buildings. The urban growth of Aksaray had resulted from the creation of opportunities without a plan for infrastructural and social consequences. However, comprehensive strategic plan was prepared just as the 2000s (Aksaray Belediyesi, 2003). The plan involves in environmental and economic development issues to urban quality of life. The strain of rapid urbanization came out in urban fabric by 2008. These observations from Aksaray could come from any other rapidly urbanizing mid-sized cities. The first development plan of Aksaray was prepared by C. Esat Arseven in 1948 (Yenice, 2017). The plan had nearly 6 ha area. This plan has a systematic way for designing residential areas around single centre in the city. Urbanization was to be a stimulant for industrialization and economic growth after 1950s. Aksaray was an Anatolian town of nearly 10000 inhabitants in 1946. Population was quickly transformed reaching 24000 in 1965 (Aksaray Belediyesi, 2003). Due to the rapidly increasing population and insufficient housing stock, it was necessary to prepare a new development plan. So, second development plan was prepared in 1967 by Development and Investment Bank of Turkey. Current area of central business district has been created in this plan. This plan put forward a systematic way for designing commercial and residential area in the city by creating squatter prevention area. The plan was prepared in 1985 with 5646 ha planned area by Mehmet Ali Topaloğlu and Bülent Berksan. The density of residential areas has been determined in 1985 Development Plan using existing cadastral data. Also, squatter prevention area has been applied with subdivision and parcellation. This plan was determined residential areas approximately 60% of planning area to solve housing needs (Aksaray Belediyesi, 2003). New residential areas started to emerge along the northern and southern axis. The most important decisions affecting the urban transport system is to put forward one of the main arterial of Aksaray. Compared with the 1985 plan and the 1967 plan, although, the share of urban land use of residential and commercial areas seems to increase, the urban open green space with urban social and technical infrastructure seems to proportionally reduced. So, this planning decisions resulted density increase, caused by changes in green areas and social and technical infrastructure areas into buildings plots. 2003 development plan that prepared by Selcuk University is an additional zoning-revision plan and continuation of the 1985 development plan. This plan was approved by the Aksaray municipality and Special Environmental Protection Agency. Different building conditions on Residential development and commercial areas have been created with this plan. Planning began with the North Development Area. The southern part of the city was planned with large parcels to rural housing areas, the northern part was a development area. Major spatial decisions of 2003 development plan are planning residential development area and the university campus area (Aksaray Belediyesi, 2003).

The reuse of historical buildings in Aksaray is very important for the sustainability of heritage. There are important historical buildings in Aksaray such as İbrahim Kaya Mansion, Guzelyurt Mansion and Corakci Mansion etc. In this study, MCDM method was used to optimize the reuse process of heritage in Aksaray, which was determined as the study area.

2. Material and Method

In this study, AHP approach is used for determining the sustainable and optimum model for adaptive reuse of heritage buildings considering the alternatives. And also, a systematic approach has been conducted on the assessment of these alternatives for adaptive reuse of historic buildings according to characteristics of each alternative. Additionally, specific objectives are defined. The methodology is used for the determination of an adaptive reuse in Aksaray case. The study may contribute to the literature with comparative analysis to determine an adaptive reuse of heritage buildings. AHP is a MCDM method which determines the criteria and weights to solve complex problems. AHP is to transform the decision problem into a typical hierarchical scheme consisting; goal, criteria and sub-criteria. AHP involves a binary comparison of the decision for a given hierarchical level (Saaty, 1977; Türk, 2018). “Binary comparisons are defined as a result of surveys conducted with decision makers (Kurdoğlu et al., 2016) (Table 1). In AHP method each criterion must be evaluated by experts. The evaluation of the adaptive reuse of heritage buildings with AHP measures the importance of different functions objectively by experts in architecture, urban planning, landscape architecture and other subjects combined with field research result.

Table 1. Definition of the importance degree of AHP fundamental scale (Saaty & Vargas, 2012)

Importance Degree	Definition
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Secondary values

Random index numbers are used for consistency ratio on the criteria (Saaty 1977) (Table 2).

Table 2. The random index numbers for consistency ratio (Saaty, 1977)

n.	3	4	5	6	7	8	9	10
RI	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Criteria (building features, accessibility, environmental value) and sub-criteria were determined by literature review in the study. Hierarchical structure scheme is given in Figure 1.

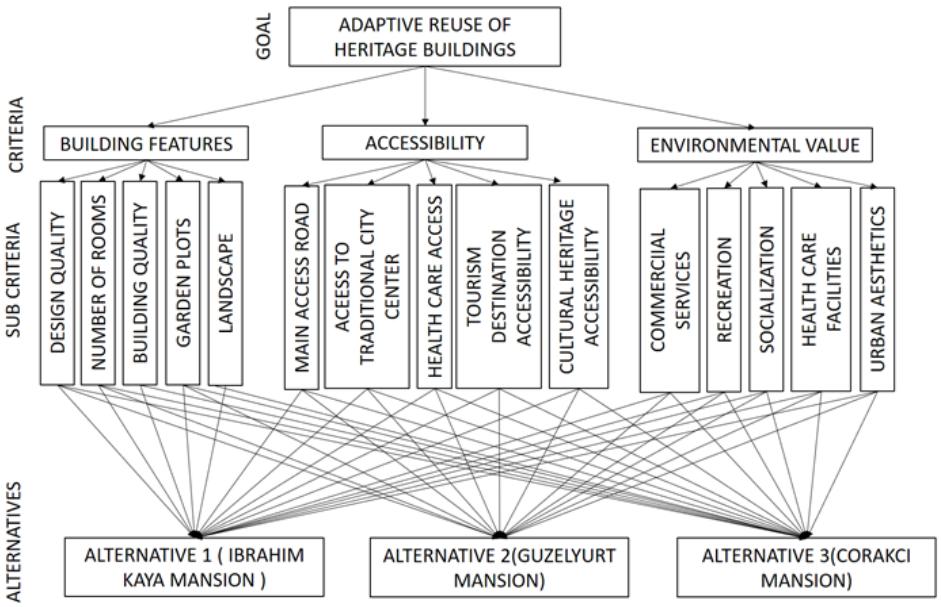

Figure 1. Hierarchical structure scheme of adaptive reuse of heritage buildings

3. Research Findings

The main characteristics of the three alternatives are listed below.

First Alternative / Ibrahim Kaya Mansion:

The mansion is located in downtown of Aksaray and at an accessible to commercial areas, health facilities, shopping centers, recreation areas. The mansion has been restored and is in good condition. The mansion with a square plan, with a total of 10 rooms, has a large courtyard. the mansion's potential superiority is accessibility to urban functions. With its design / building quality and accessibility, this mansion is expected to be a good alternative to adaptive reuse of heritage buildings.

Second Alternative / Guzelyurt Mansion:

The mansion is located in the center of Güzelyurt settlement and has high accessibility to historical places. This

mansion has not been restored and is in dilapidated condition. The mansion has a total of 10 rooms and has an inner courtyard. With its location and landscape, this alternative is expected to contribute to adaptive reuse of heritage buildings.

Third Alternative / Corakci Mansion:

The mansion is located close to the center and main access road. the mansion has not been restored and is in dilapidated condition. The mansion has a total of 10 large rooms and has a big courtyard. This alternative can be expected to contribute to adaptive reuse of heritage buildings by recreation and socialization.

The weighting score for criteria to an adaptive reuse of heritage buildings is given in Table 3.

Table 3. The weighting score for criteria to an adaptive reuse of heritage buildings

Goal	Main Criteria	Weighting Score	Sub Criteria	Weighting Score	Weighting Scores of Alternatives		
					A1	A2	A3
Adaptive reuse of heritage buildings	Building Features	0.416	Design quality	0.153	0.518	0.132	0.350
			Number of rooms	0.049	0.365	0.223	0.412
			Building quality	0.257	0.552	0.166	0.282
			Garden plots	0.177	0.443	0.282	0.275
			Landscape	0.364	0.285	0.384	0.331
	Accessibility	0.321	Main access road	0.115	0.376	0.120	0.504
			Access to traditional city center	0.182	0.487	0.156	0.357
			Health care access	0.139	0.433	0.148	0.419
			Tourism destination accessibility	0.359	0.230	0.457	0.313
			Cultural heritage accessibility	0.205	0.191	0.494	0.315
	Environmental value	0.263	Commercial services	0.110	0.434	0.133	0.433
			Recreation	0.162	0.333	0.190	0.477
			Socialization	0.270	0.324	0.135	0.541
			Health care facilities	0.201	0.438	0.149	0.413
			Urban aesthetics	0.257	0.387	0.212	0.401
Inconsistency rate	0.00133						

The main findings of the three alternatives are listed below.

Alternative 1. Community based – Public services: Contributing to social life and developing community awareness through functions such as libraries and community activity centers. Reusing of the building as libraries and community activity centers is possible because it requires only minor intervention and will increase the public use of the building. It will contribute to the urban identity because of the public functions around it and its accessibility.

Alternative 2. Nature and history based- mix use of nature/culture interactions: Contributing to cultural heritage through museums, galleries, exhibition centers or auditoriums. The best performing reuse for this building are the museums galleries, exhibition centers or auditoriums; because the building is in harmony with the historical texture around it.

Alternative 3. Economics based - Commercial and tourism services: Contributing to the economy through shops, restaurants and boutique hotels. The building provides the most benefit from the surrounding areas by areas that commercial, tourism and residential uses.

The comparison of the alternatives considering to main criteria is given in Figure 2.

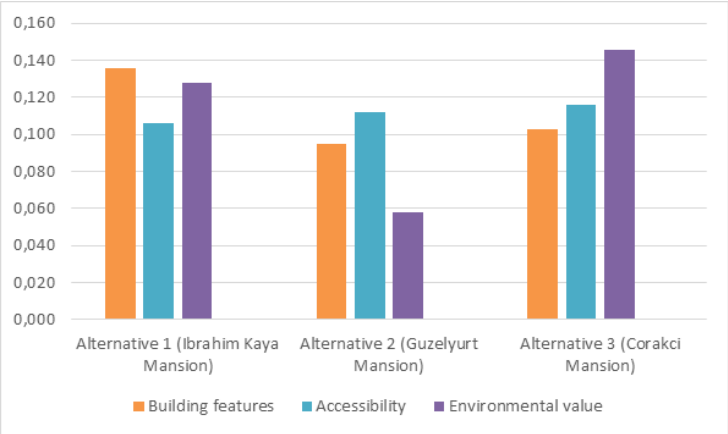

Figure 2. *The comparison of the alternatives considering to main criteria*

The specifications for the alternatives is given in Figure 3.

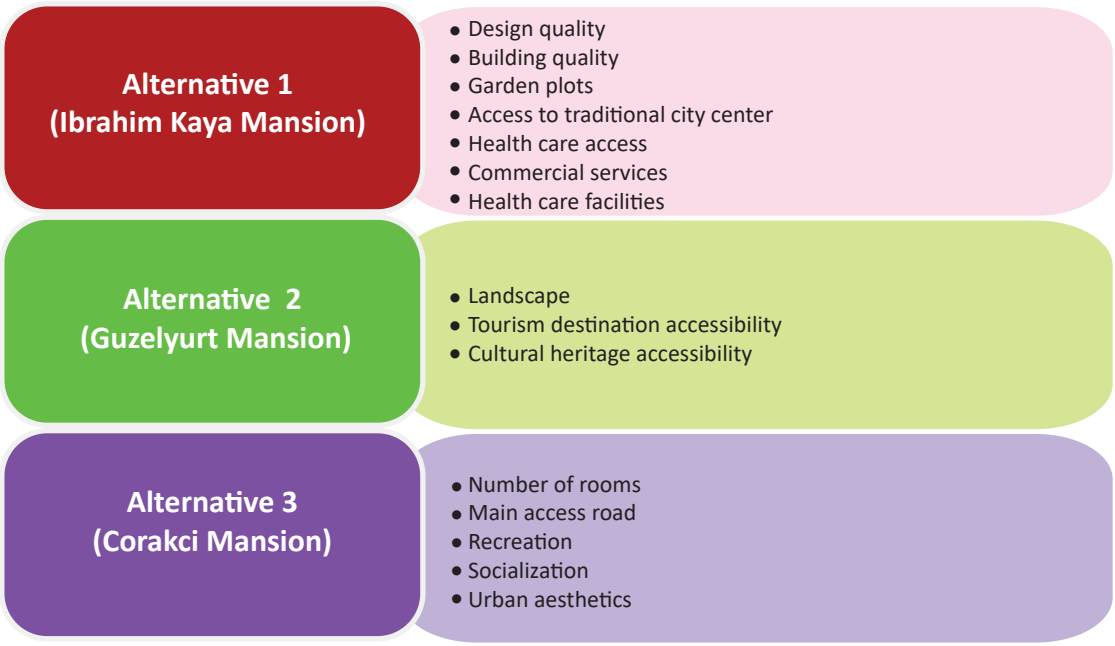

Figure 3. Specifications for the alternatives

4. Conclusion

In the study, AHP model was developed by literature review and the priority order of the alternatives were determined. The decision-making model was used to develop the direction and framework for the reuse of historic buildings. Building features, accessibility, and environmental value were determined as main criteria and these criteria affected the priority order of historical buildings reuse alternatives. Each alternative has been evaluated against functional requirements and building characteristics. The reuse of alternatives is planned to balance conservation and development. As a result, identification of potential function with AHP model weighted evaluation is crucial argument for ensuring sustainability of heritage buildings.

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