Adaptive reuse as an approach to sustainability

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Abstract. Adaptive reuse of buildings serves well the needs of the local community and leads to sustainable economic, social and environmental development; therefore, it is necessary to search the role that adaptive reuse plays in the sustainability of the heritage buildings. The research problem is represented by a knowledge gap about the impact of the determinants of adaptive reuse and its benefits that leads to the sustainability of the reused buildings. The aim of the research is to build a theoretical framework that helps to determine this impact. The research adopts the descriptive analytical approach to some of global, Arabian and local samples elected on the basis of the difference in the new function compared to the old one, the difference in the benefits of reuse achieved in the samples, the difference in the culture and nature of society in the chosen areas of the projects and the fact that the projects are carefully designed to preserve the originality of the architectural heritage. Finally, the research has reached some conclusions and proposed a number of recommendations based on the results of a practical study aimed at achieving the sustainability of local heritage buildings by reusing them again.

1. Introduction
Adaptive reuse is a form of sustainable urban renewal as it prolongs the building’s life. It is not only a process of converting buildings by recycling their usable components for a new use, but also a method and strategy that can be used to preserve cultural heritage. It is a process of renovating the old or obsolete building while maintaining the historic and cultural heritage and create a new dynamism in line with the spirit and requirements of the times.

2. Research problem, hypothesis, aim, methodology
The research problem has been identified by a knowledge gap on the impact of the determinants of adaptive reuse and its benefits that lead to the sustainability of reused buildings. According to the above, the research hypothesis is determined that heritage building sustainability is achieved through the verification of the determinants of adaptive reuse represented by the requirements of the building, the requirements of its surroundings and the benefits of adaptive reuse.

The research aims to define building requirements and its surroundings that lead to successful adaptive reuse and sustainability of heritage buildings as well as to determine the benefits of adaptive reuse of heritage buildings that lead to their sustainability. In order to achieve these aims, the study has built a theoretical framework to describe the relationship between the benefits of adaptive reuse, the pillars of sustainable development and the determinants that lead to the success of the adaptive reuse process to preserve the heritage buildings. The vocabulary of the theoretical framework is applied to global, Arabian and local projects in order to know the effect of each item on the success of reusing and sustaining these projects. Finally, the study ends with conclusions and proposes recommendations in accordance with the attained results.
3. Definition of adaptive reuse

Yung and Chan (2012, p: 353) defines adaptive reuse as a form of sustainable urban renewal to extend and renovate the building's life instead of demolishing or destroying it, as well as, such process would have social, environmental and economic profits for the whole world. [1]

Fiorani (2017, p: 1) in his book Conservation - Adaption describes adaptive reuse as the process of changing a building's entire function through which the function is the most obvious change, but other adjustments can be made to the building itself, such as orientation, and the relationship between spaces; additions may be built and other areas may be demolished. In addition to preserving the physical values of buildings or sites, an important aspect of reuse is maintaining the immaterial importance. This is especially important in the case of symbolic buildings or sites where the spirit of the place is important, such as those that have a social, political, memorial, or religious meaning, or those with a negative history; that is to say, the design has to create a harmony of form, function and spirit. [2]

While Schmidt (2009) defined adaptive reuse as being the ability of a building to reflect and respond to the necessary developed requirements of the users and to the constant change in an effective way and thus maximizing value during life. [3]

From the above, adaptive reuse can be defined as: reuse the function of old or abandoned heritage buildings to meet the contemporary requirements and increase the value of the building by increasing its life cycle which leads to the sustainability of heritage buildings.

4. Literature review

4.1 Rathmann Study (1998):
Rathmann (1998, p: 58) indicated in his article 'Architectural Reuse' in the book Recycling and Reuse of Building Materials that adaptive reuse deals with the change in the functional needs of society from the building. [4]

The study examined the benefits of the reuse process and indicated that it extends beyond preserving our cultural heritage. Old buildings can have economic value through tax credits and reduce demolitions and related material costs. He showed that when designing buildings, it is necessary to think about the possibility of changing the building’s function in the future in order to adapt to the functional changes as a result of changing requirements and conditions.

4.2 Zachery E. Fein Study, 2010-2011,
This study tackled adaptive reuse strategies and indicated that they are divided into two groups:[5]
- First: Strategies that do not take the aesthetic heritage value of the building into consideration and include: Renovation - Demolition - Replacement
- Second: Strategies that take into consideration the aesthetic heritage value of the building and include: Reconstruction, and Re-read the site of the historic structure.

4.3 Noureddine, study (2015):
Mohamed Nour El-Din (2015, p: 208, 209, 2010) mentioned in his article The Importance Of Re-function In Preserving Heritage Buildings Of Historical Value that there are limitations and requirements for the re-use of heritage buildings of value and these requirements include: [6]
- First: Building requirements:
  The building requirements include architectural and structural compatibility.
- Second: Requirements for the building's urban surroundings:
  It includes both social planning and urban convenience.

4.4 Dyson K. & other study, (2016):
The study confirmed that adaptive reuse represents a form of sustainable development as adaptive reuse has provided social, environmental and economic benefits, as follows: [7]
- Social benefits: The presence of a large number of vacant or abandoned buildings within the city has a negative impact on society, provides an environment and other antisocial behaviours. The
adaptive reuse project must ensure that all stakeholders receive benefits if it is intended to be successful, and it can also provide additional jobs for local residents when using adaptive reuse.

- Environmental benefits: The benefits of this approach to construction include lower landfilling rates, reduced material generation, reduced urbanization and use of infrastructure.
- Economic benefits: Adaptive reuse projects are more cost-effective due to demolition and reuse of structural elements, and are more efficient and effective in providing vital space, compared to demolishing and rebuilding a new building. Another advantage is having a shorter construction period. These factors not only increase the value of the building in question but also increase the value of the surrounding real estate.

4.5 Study of Sugden E. 2017
The study entitled *Adaptive Reuse of Industrial Heritage Buildings* by Sugden dealt with a set of criteria and factors that affect adaptive reuse and made it clear that they have represented the conditions for successful adaptation in heritage buildings and showed the ratio of the impact of each effect of these factors (cultural, economic, environmental, legislative, local, new use, social, project team, local municipality, and timing).[8]

![Figure 1. Showing the ratio of each criterion influencing a process of adaptive reuse according to (Sugden, 2017) (Prepared by the researcher).](image)

Where the study showed that these factors contribute to the following basic functional and enabling competencies shown in Fig. (2):

![Figure 2. Functional and enabling competencies, source: [8, p112]](image)
6. Vocabulary of the abstract theoretical framework

Literature review have indicated a set of major and secondary vocabulary, their indicators and possible rates for them, which were drawn out and from which the theoretical framework for the research has concluded as shown in Table No. (1)

First item: The benefits of adaptive reuse that achieve sustainable development of heritage buildings

There is a need to reuse historic buildings in a renewed manner to revitalize these buildings and maximize their socially, economically, and environmentally sustainable values. The table below shows the relationship between the pillars of sustainable development and the benefits of adaptive reuse. . [9]

Table 1. The relationship between the pillars of sustainable development and the benefits of adaptive reuse [9]

| pillars of sustainable development | benefits of adaptive reuse |
|-----------------------------------|-----------------------------|
| Environmental                     | enhancing environment.     |
| Environmental - Economic          | Use of fewer resources, energy, and emissions |
|                                   | Boosting demand for existing maintained buildings. |
|                                   | Stimulate vacant neighbourhoods. |
|                                   | The recovery of energy embodied in buildings over a large period of time. |
| Economic                          | economic growth.            |
|                                   | More cost-effective         |
| Economic-social                   | expansion of the life cycle of buildings. |
|                                   | Giving value to the community resources from unproductive real estate. |
| Social                            | cultural continuity, identity, and sense of place. |
|                                   | Giving a better aesthetic appearance to the built environment. |
|                                   | Preserving heritage and presentation. |
| Socio-environmental               | decrease in land consumption and urban decline. |
|                                   | Revitalizing and developing heritage areas and architectural and technical innovations. |

Second item: reuse determinants:

Some general determinants of the success of the adaptive reuse process of heritage buildings have been set in accordance with international covenants and recommendations. As they have included some of the requirements of the building and the surrounding urban area, as follows: [10]

A - Building requirements: It includes:
- The convenience of the proposed use of the building's cultural and historical value.
- The convenience of the proposed use of the optical character and architectural form of the building, interior design, the vertical and horizontal movement elements, and the external elements.
- The suitability of the proposed use of the structural elements in the building.

B - Requirements of the surroundings: The proposed use of the heritage building should contribute to developing the surrounding urban environment through:
- The suitability of the proposed use to the needs and value of the surrounding community: The proposed use should be appropriate to the value of the building and integrate it with the surrounding community and achieve a balance between the potentials of the building and the needs of the community.
- The suitability of the proposed use for designing the surrounding area: The blending of the building with the surrounding urban area is one of the factors leads to successful adaptive reuse process, and it is a factor in solving the surrounding urban problems and developing the area in terms of providing access to the building and parking.
7. Abstract theoretical framework
Table (2) illustrates the theoretical framework extracted for the relationship between adaptive reuse and sustainable development and includes the main vocabulary with the secondary vocabulary, and the possible values for each item.

| benefits of adaptive reuse | main vocabulary | secondary vocabulary | the possible values |
|---------------------------|-----------------|----------------------|--------------------|
|                           | Raise the environmental aspect | The reuse process reduces pollution | | |
|                           |                  | Reuse of heritage buildings improves infrastructure networks | | |
|                           |                  | To preserve the “power involved” of the original building | | |
|                           |                  | Adaptive reuse reduces energy demand and carbon emissions | | |
|                           |                  | Adaptive reuse contributes to limiting urbanization | | |
|                           | Lift the architectural side | Adaptive reuse contributes to restoring the building's architectural shape to life again and getting rid of deteriorated parts of the building by restoring it. | | |
|                           |                  | Adaptive reuse contributes to the maintenance and repair of the building's structural structure | | |
|                           |                  | Adaptive reuse maintains the building's functional value | | |
|                           |                  | Adaptive reuse maintains important buildings | | |
|                           |                  | Adaptive reuse contributes to meeting physical and technical needs | | |
| Lifting the urban side    |                  | Preserving the urban landscape | | |
|                           | Improving the social aspect | Adaptive reuse contributes to job creation for the population | | |
|                           |                  | Adaptive reuse contributes to the recognition of pluralism | | |
|                           |                  | Adaptive reuse contributes to the continuity of social life | | |
|                           |                  | Adaptive reuse contributes to the development of community participation | | |
|                           |                  | Adaptive reuse contributes to improved social cohesion | | |
|                           |                  | Adaptive reuse contributes to cultivating a cultural awareness of the population and improving their behaviour and habits | | |
| Improving the economic aspect |                  | Adaptive reuse leads to less construction time than a new building for a new job | | |
| cultural benefits         |                  | Adaptive reuse leads to less construction time than a new building for a new job | | |
|                           |                  | Change the classification of the functional building | | |
|                           |                  | Maintains the cultural importance of preserved structures | | |
| Political benefits        |                  | Adaptive reuse imposes construction restrictions | | |
|                           |                  | Adaptive reuse contributes to preparing proposals for new uses | | |
|                           | Buildings Requirements | Cultural | For a job with building values | | |
|                           |                  | Visual | Interventions with the exterior of the building | | |
|                           |                  | Architecture | Old look and spaces with new use | |
8. Measuring indicators

8.1 Measurement
Through which all possible values for each project that were accomplished by the researchers are tested, based on the information extracted from the general description and the special description of the elected project and for each individual according to its specificity, and in a manner consistent with the project goal, where the measurement mechanism for the vocabulary was aimed at knowing the percentage of verification of each indicator of the indicators of the vocabulary of the theoretical framework and comparison between samples.

8.2 Measuring method
The research adopted the qualitative measurement by setting a set of values for each indicator where the indicator’s verification is entirely symbolized by a number (1), the indicator was partially achieved by the number (0.5) and the indicators are not achieved in the project with the number (0).

8.3 Method of Measurement:
The research adopted the descriptive analytical approach based on the analysis of detailed texts, drawings and illustrations for a number of global, Arabian and local projects, and analyzed according to the SPSS program. The analysis process includes a general description of the project, the mechanisms of adaptive reuse and the benefits of adaptive reuse that achieve the sustainability of heritage buildings in the project depending on the sources, and re-analysis of each project according to the specific vocabulary of the measurement based on the description, designs and illustrations.

9. Criteria for selecting samples for practical study
After determining the most important vocabulary and measurement method, the research adopted the following criteria for selecting samples for practical study:
• Selecting heritage projects that have been reused for a new function that differs from the original building function.
• Approving projects that adopt adaptive reuse to preserve the heritage.
• The difference in benefits and requirements achieved in the project.
• The difference in the culture and nature of society in the regions in which the projects were chosen.

10. Global, Arabian and local case studies
10.1 Global case studies
Penang Hotel
Georgetown - northern states of Malaysia
Residential
Hotel
Penang Hotel originally consisted of three duplex houses and terraces, the houses most likely built in the 1920s and renovated after the war. The general concept of the building was to transform the site into a hotel with a financially and commercially viable option. The original buildings were utilitarian and simple. This was the...
challenge the designer faced, and how to preserve his heritage personality. The palace is located in a densely populated urban area, dating back to the Middle Ages.

| The benefits of adaptive reuse | The project achieved the green aspects of the adaptive reuse of Penaga Hotel) gold in the index (GBI) which scores (76 points) out of (100). The indicators achieved by the project:
1. Energy Efficiency
   Solar panels have been added to the top of the surface. Optical duplexes that generate additional electricity.
   The electricity that is produced is used to heat water and daylight, and it has been proven that the use of solar panels has a positive effect on both the physical and mental state of people and thus, it is a way to provide electricity and keep the user positive and healthy. The hotel also uses the optical sensor in the corridor to reduce electricity use.
   Custom controls and temperature sensors were also added and saving energy (60%).
2. Quality of the internal environment
   The hotel focuses on the widespread use of LED lamps. Besides, to control the glare of daylight, stained and reflective glass windows were used, and the wide window opening provides maximum outdoor visibility and daylight to occupy the building. In order to avoid indoor air pollutants, sealants and adhesives products and sealants were used throughout the building.
3. Articles and resources
   During the restoration and redevelopment process, the hotel saved and reused the existing materials. For example (50%) of the wood used as treated wood has been certified
4. Water efficiency
   For efficient use of water, rain water harvesting method has been applied. Water was used to irrigate the plant. And in the pool. Water-efficiency installations also reduce water use, for example reducing drinking water consumption by 50%. |
the project is a prominent example of the privately financed adaptive reuse conservation project
At the building level
- At least from a material and aesthetic point of view. The resulting architectural and interior design work was simple, stunning and beautiful.
- The house intervention did not change the values achieved by the project but rather some minor restorations and adding elements that achieve sustainability standards in
At the surrounding urban area level
- It was successful in his goal to re-create the heritage atmosphere of the old city
- The site where sustainable features and energy efficiency were integrated into the building. In addition to smart landscape solutions and the seamless integration of the building with the landscape.

10.2 The Arabian case studies

| Project | Muhammad Ali Palace [6] |
|---------|-------------------------|
| project site | Egypt / Shubra |
| Old use | headquarters of special ceremonies and receiving delegations from ambassadors and consuls to Egypt |
| New use | tourist attraction and a world centre to receive visitors and hold conferences |
| project description | known as the Palace of Fasqa, and it is one of the important palaces in Egypt. It was built in 1821 during the reign of Muhammad Ali Pasha and testifies to an important historical period in Egypt. The palace has architectural value as it was built on the pattern of Turkish palaces, and was built within a group of residential buildings. |
The sustainability elements that the project focused on became an income-generating through the use of the building as a tourist attraction or as a conference hall or celebrations where it became a stable economic resource.

Factors that affected the success of the reuse project:

Economic factors: financing the restoration of the palace at a value of 50 million Egyptian pound.

The palace and the surrounding urban area have been restored in several stages for reuse:

At the building level:
A- Structural restoration: The foundations were strengthened, moisture was treated in the walls of the palace, the sewage network was changed, and the wooden truss-bearing roof was restored.
B- Architectural restoration: The marble elements in the palace, columns, statues and restoration of the decorative elements and halls were restored.

At the surrounding urban area level:
A- Removing slums and establishing alternatives to them.
B- Preserving the trees and plants in the area.
T - separating the movement of cars and pedestrians, designing movement paths to serve tourists and setting up parking lots.
W- Improving social life in the urban area of the palace.

### Determinants of adaptive reuse

The project The palace and the surrounding urban area have been restored in several stages for reuse.

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- At the surrounding urban area level:
  - Removing slums and establishing alternatives to them.
  - Preserving the trees and plants in the area.
  - Separating the movement of cars and pedestrians, designing movement paths to serve tourists and setting up parking lots.
  - Improving social life in the urban area of the palace.

### 10.3 local case studies

| Project | Palace of Culture and Arts [12] |
|---|---|
| project site | Basra - Iraq |
| Old use | residential |
| New use | cultural |

**project description**

The construction period dates back to the late Ottoman period, the original owner of this building is Sheikh Khazaal Al-Kaabi, Emir of Muhammarah, and historical sources state that he bought a house built and his family lived in it because his original residence was in Muhammarah.

There is another house belonging to him called Dar Al-Sheikh Khazaal (House of Women), but it is a separate house that has all the architectural and artistic features in addition to its planning, it consists of two floors, each floor includes four wings, and the facade of the house overlooks the Al-Ashar River.

This house was acquired by the General Organization for Tourism in 1979 to be part of the project to develop heritage homes in old Basra and was maintained. When the project stopped, its acquisition was transferred to Basra Governorate, then leased to several government agencies and currently to the Palace of Culture and Arts in Basra. Some parts of the home have been serviced for re-employment.
The adaptive reuse benefits previously mentioned were not realized as there was a weakness in:
- Service activities and elements that attract the public and that lead to tourism
- Technical monitoring of the building, which sometimes led to additions that harm the building.
- Merging the reused building with the surrounding life.

The adaptive reuse setting previously mentioned were not fulfilled as:
- At the building level:
  - Inappropriateness of horizontal plans and interior spaces for the new use of the building.
  - Failure to use materials compatible with the original heritage materials in the building, which led to a change in the shape of the building and its negative impact.
- At the surrounding urban area level:
  - The deterioration of the built environment and the lack of attention to or improvement in the urban area surrounding the project.

### 11. Results

**11.1 Results of the benefits of adaptive reuse that achieve the sustainability of heritage buildings:**

Table 3. Investigated each of the vocabulary benefits of adaptive reuse in the global, Arabian and local samples. Source: case study results.

| benefits of adaptive reuse | Pena ng hotel | Moh ame d A. pa la ce | Cult ure & art pa la ce |
|----------------------------|---------------|----------------------|------------------------|
| **Raise the environmental aspect** | The reuse process reduces pollution | 1 | 0.5 | 0.5 |
| | Reuse of heritage buildings improves infrastructure networks | 1 | 1 | 0 |
| | To preserve the "power involved" of the original building | 1 | 0.5 | 0.5 |
| | Adaptive reuse reduces energy demand and carbon emissions | 1 | 0 | 0 |
| | Adaptive reuse contributes to limiting urbanization | 1 | 1 | 0.5 |
| **Lift the architectural side** | Adaptive reuse contributes to restoring the building's architectural shape to life again and getting rid of deteriorated parts of the building by restoring it | 1 | 1 | 0.5 |
| | Adaptive reuse contributes to the maintenance and repair of the building's structural structure | 1 | 1 | 0 |
| | Adaptive reuse maintains the building’s functional value | 1 | 1 | 0.5 |
| | Adaptive reuse maintains important buildings | 1 | 1 | 0.5 |
| | Adaptive reuse contributes to meeting physical and technical | 1 | 1 | 0 |
We note from the results in Table (3), fig. (3) that the Penang Hotel project has achieved the highest rates of adaptive reuse benefits as the works that were applied in the project respect the environment and sustainability, so we note that the project has contributed to achieving most of the benefits of adaptive reuse at a rate of (100%) except for improving the social aspect was (66.7%) because the project focused on economic and environmental benefits. The statistical results have shown that the final rate for achieving the benefits of adaptive reuse is (83.3%) as a whole and partially at a rate of (16.7%).

As it turns out that the sustainability rate of the heritage building was very high in the global sample, which indicates the reason for the project obtaining 75 out of 100 in the GBI green buildings index and this shows the importance of adaptive reuse in the sustainability of reused buildings.

![Figure 3. Rate of the vocabulary benefits of adaptive reuse in the global samples](source: case study results.)
We note through the results in Table (3), Fig.(4) that the Arabian sample has achieved the benefits of usually completely adaptive use in varying proportions, so the urban and architectural aspect has been raised at a high rate because the project has preserved the aesthetic and architectural value in the building as it was concerned with proportionality with the urban fabric surrounding the building, the economic benefits have been partially achieved by a rate of (100%), because the amount prepared for the restoration of the project is huge, approximately (50 million Egyptian pounds), although the palace has become an important economic resource, while political benefits have been achieved (100%) in part, As for the environmental benefits, the project has led to the improvement of infrastructure networks and reduces urban expansion by (100%), and also partly contributed to preserving the energy contained in the building and reducing pollution, so the final rate to achieve the benefit of raising the environmental side was fully achieved by (40%) and partially achieved by (40%), and (20%) unrealized, as for the benefit of improving the social aspect was achieved by (66.7%) since the project contributed to improving the social life in the urban area surrounding the palace and contributed to social sustainability.

**Figure 4.** Rate of the vocabulary benefits of adaptive reuse in the Arabian samples.

Source: case study results.

The results of the local sample showed in Table (3), Fig. (5) that the benefits of adaptive reuse in general were unrealized, as the percentage of non-achievement of indicators in terms of total (33.3%) or indicators that were partially achieved by (58.3%) and the indicators achieved in a total rate of (8.3%). Table (3) shows the percentage of each indicator achieving the benefits of adaptive reuse in the Palace of Culture and Arts project, as the project contributed to reducing the percentage of pollution, preserving the energy included and limiting urban expansion by (50%). It did not contribute to reducing carbon emissions or improving infrastructure networks, in terms of architectural benefits only. The project contributed to bringing the architectural form of the building back to life and maintained an important building at a rate of(50%), but it did not contribute to meeting the material and technical needs of the building and did not lead to the ongoing maintenance of the building's structural structure. Some parts of the building structure are still damaged and no restoration process or maintenance has taken place. No benefit was achieved raising the urban side in the area surrounding the site and did not contribute to its development, the project contributed to achieving social benefits with a small percentage in terms of developing community participation and social cohesion because the project is a centre where celebrations and cultural plays are held from time to time. The rest of the variables of social benefits were not achieved in the project as they did not achieve high economic benefits, and they did not generate material income consistent with the amounts spent to restore them, and only 66% of the economic benefits were partially achieved. As for the political benefits, none of them was achieved due to negligence. The local government for these projects, and because the project is sometimes used for cultural purposes, has contributed to achieving this benefit, but only partially and not as expected from the cultural benefits that heritage buildings can achieve.
Figure 5. Rate of the vocabulary benefits of adaptive reuse in the local samples. Source: case study results.

11.2 Results of adaptive reuse determinants:

Table 4. Investigated each of the vocabulary determinants of adaptive reuse in the global, Arabian and local samples, source: case study results.

| Determinants of adaptive reuse | Penang hotel | Mohamed A. palace | Culture & art palace |
|--------------------------------|--------------|-------------------|----------------------|
| **Building Reuse Requirements** |              |                   |                      |
| Convenience                    | Cultural     | For a job with building values | 1 | 0.5 | 0.5 |
|                                  | Visual       | Interventions with the exterior of the building | 1 | 0 | 0 |
|                                  | Architectural | Old look and spaces with new use | 0.5 | 0 | 0 |
|                                  | Structural   | It is suitable for construction and new use | 0.5 | 0.5 | 0.5 |
| **Surrounding urban requirements** | Integration | Between architectural elements such as entrances and spaces with the new use | 1 | 1 | 0 |
| **Social Fit**                  | The balance between the new job and community values | 1 | 0 | 0.5 |
|                                  | Alignment between the new job and the needs of society | 0.5 | 0 | 0.5 |
| **Urban fitness**               | Adaptation and urban plans for the surrounding environment | 0.5 | 1 | 0 |

The results of the global sample project related to the determinants of re-use as shown in table (4), Fig. (6) showed that the indicators of the item were achieved at a rate of 75% in total and related to both the requirements of the building and the environment, where the requirements of the building were achieved by (80%) in total and (20%) in part, both the cultural and visual suitability and the individual integration were achieved by (100%), the architectural and construction appropriateness was partially fulfilled by (50%), while the requirements of the surroundings were fulfilled by (75%) in total and (25%) in part, the social suitability between the new function, community values and community needs was partially achieved (50%). As for the urban appropriateness, it was achieved at (100%) in the project. We note that the requirements of adaptive reuse have led to the success of adaptive reuse, thus led to achieving the required benefits for the sustainability of heritage buildings.
The results of the Arab sample, as shown in Table (4), Fig. (7) related to the second item, showed that they are fully achieved at a rate of (50%) and partly (50%) which related to both the building requirements and the requirements of the surroundings where the building requirements were Partially achieved by (40%) and totally by (60%) of the requirements of the building, therefore, each of the architectural, structural, and visual feasibility was achieved at a rate of (100%), while the cultural feasibility was partially fulfilled by (50%), and the requirements of surroundings were partially fulfilled by (33.3%) and (66.7%) as a whole, the social convenience between the new function and community values was partially achieved by (50%), while the urban and function suitability to the values of society were attained at a rate of (100%) in the project.

The results of the practical study shows that the local sample, as shown in Table (4), Fig (8), did not achieve any of the indicators of the determinants of adaptive reuse in a totally way, where the percentage of partial verification (87.5%), while the percentage of unverified indicators is (12.5%), where the requirements of the building were not fulfilled by (20%) partially and (80%) wholly of the requirements of the building altogether, both the architectural and visual feasibility of the project was not achieved, the cultural and construction appropriateness was partially fulfilled by (50%), while the requirements of the surrounding were partially achieved by (66.6%), social convenience between the new function, community values and social needs was partially achieved (50%). As for urban suitability, it was not achieved in the project.
Figure 8. Rate of the vocabulary determinants of adaptive reuse in the local samples. Source: case study results.

12. Conclusions
1. Sustainability has become a more important factor in reuse decisions making; however, economic outcomes still tend to be the criteria that determine whether buildings are considered suitable for reuse. The extent to which adaptive improvement relates to the commercial and operating performance of a building is influenced by results that meet sustainability objectives with a set of complex criteria. They are categorized according to the concepts of environmental, social, economic and governance sustainability.
2. The heritage that has social functions must be protected and reused by the state.
3. When applying adaptive reuse to a heritage site, the character must be preserved and its characteristics and advantages must be enriched.
4. The adaptive reuse is part of economic development because heritage is an important economic resource.
5. Adaptive reuse of heritage sites should conform to the character of the urban area or the historical city character; therefore, it is necessary to develop these areas and improve public services to keep pace with modern life.
6. Improper reuse causes damage through unnecessary additions or inappropriate changes.
7. Every effort must be made to make the new use compatible with the old one and require only minimal change and conform to the original movement patterns of the building.
8. The charters mentioned that adaptive reuse includes conversion and addition.
9. Adequate technologies and methods must be developed to preserve the adaptive reuse.
10. The importance of financing for preserving the heritage and adaptive reuse

13. Recommendations
1- Evaluating the benefits that adaptive reuse can provide individually.
2- Matching the sustainability criteria with the expected results of the reused projects.
3- Sharing the community’s opinion about the new use of the building, especially in the old areas.
4- Raising awareness about the benefits of the re-use of heritage buildings, especially by universities.
5- The necessity of governmental and political support for the reuse of heritage buildings in terms of giving tax exemptions on reused buildings, and providing grants to the private sector that includes a concession period that is determined through agreements that include re-use under the supervision of government agencies and for a specific use. In return for material benefit from the building for the specified period, it is conditional on handing the building over to the government agency at the end of the period.
6- Establishing an investment fund to support adaptive reuse projects
7- Encouraging tourism in heritage areas to enhance the economic feasibility of new use.
8- Formulating guidelines for reuse of heritage buildings that help integrate this use with the concepts of sustainability
9- Launching incentives to attract people to settle in the old heritage areas, such as reducing real estate prices and rentals.
10- The building design should blend with the surrounding environment and society, so innovative designs should be implemented and historical and heritage elements preserved, and they must be structurally sound and strong to be durable.
11- The materials of the original structure must be preserved and used ideally if they are not shabby. New and maintained additions can be a mixture of old and new building materials.
12- The building should be able to make future changes and adapt to other reuse options in case the change of use is needed due to community demands or economic requirements.

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