Adaptive reuse in neglected industrial buildings (Industrial buildings in the Iraqi Ministry of Oil)

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Abstract. The economy restructuring results in industries transformation from one area to another in part or whole, and this phenomenon has left huge numbers of abandoned constructions and sites. In Iraqi oil projects, due to the lack of land in vital industrial areas and a large number of neglected buildings (after no longer needed), the shortage of buildings has been a trouble for several years. Adaptive reuse of industrial buildings may solve this problem. However, it is not a mere procedure because some determinants affect it. Therefore, the research problem was represented by "lack of comprehensive knowledge of the adaptive reuse determinants in neglected industrial buildings," and the research aimed to present its determinants and determine its precedence in terms of use in industrial buildings.

1. Introduction
The development of activities and events in the Iraqi oil sector has led to the construction of new industrial buildings and facilities to keep pace with the immediate needs of the country, and this has resulted in the leaving of many industrial buildings, and a few lands in vital industrial areas as shown in Figure 1.

![Figure 1](image)

**Figure 1.** shows some neglected industrial buildings in the Iraqi Ministry of Oil/ Baghdad- AlTaji

The first axis is the introduction of linguistic and idiomatic definitions of concepts related to research, then a group of studies that dealt with the relationship between them are presented, so that the research problem can be reached. After that, the research presents a group of the main paragraphs and applying them through conducting a questionnaire for a group of engineers in the Iraqi oil sector of all specialities related to industrial buildings, to show the most effective and effective criteria for adaptive reuse in neglected industrial buildings. Thus, they are a useful reference for different decision-makers for future industrial projects.

2. Linguistic and idiomatic definition
2.1. Adaptive reuse

Some researchers indicated that the concept of reuse means re-employing the building with its original function, for which it was created without making any modification or change in its buildings while carrying out the necessary rehabilitation operations, as is the case in most of the preservation buildings that were restored in Iraq because reusing the building in its job. The original one fits his situation and his engineering and its capabilities without the need to make an amendment and a switch that might harm its originality and prestige. Some researchers added the word Adaptive the original word to become the Adaptive reuse to give the meaning of reuse as the building adapts to the new function without inconsistency. Consequently, the term Reuse has become different from the term Adaptive reuse to mean modifying, transferring or changing the function of buildings that lost their original function while they are in good construction condition to other new uses that suit the current needs and ensure the protection of the building. Often the process of reuse accompanies structural or space changes in the building according to its new function, which helps to rehabilitate it and integrate it with the urban and social fabric of the ocean instead of being a closed impact, thus ensuring the continuity of the life of these buildings and practically maintaining them, taking into consideration that any changes of these building should be minimal.

In general, multiple definitions of adaptive reuse have been introduced, including:

- To achieve more effective results, instead of extracting raw building materials during demolition or dismantling and adopting them in new projects, adaptive reuse represents leaving the building structure intact, but its use is changing [1].
- It represents the process of changing the use of an ineffective old building into a new building that can be used for various new purpose.
- It is the process of changing the use of an ineffective old building into a new building that can be used for various new purpose.

From previous definitions, it can be concluded that adaptive reuse represents a procedure of architectural renewal that transforms existing constructions into other usages, to achieve economic, social and functional goals.

2.2. Adaptive reuse in industrial buildings

Industrial buildings represent installations used for industrial activities. These buildings began to emerge from their beginnings during the industrial revolution as a specific architectural type during the eighteenth and nineteenth centuries when new activities and the availability of new materials and technologies emerged to create some buildings to meet specific needs in more innovative ways in that period. In general, industrial buildings are divided into four main classes: standard industrial buildings, following standardized forms to operate them from different industries [3]. Buildings of special requirements, which are built according to specific requirements, vary greatly and vary in terms of area, shape, and number of floors, and depend on that on industry requirements and site conditions [4]. Storage buildings, which are linked to the method of loading and unloading materials, determining the construction often on one floor and the internal height to suit the reach of the cranes [5]. Finally, Workshops buildings, which are considered as the smallest industrial units, which can occupy an independent building or part of a larger building due to its very small size, which often ranges between (30) and (150) square meters [6].

The building’s construction of these requires large sums whether to provide them with a plot of land, in addition to the costs of building structures and buildings, so the absence of the need from the industrial building represents a waste of all of these resources. Besides, with time, the existing buildings become old or deserted, and the operational and marketable performance of the building will decline over the period till it falls short of the anticipation of owners and occupants the same. Decisions must be made here to either pull down and reconstruct or adapt existing buildings to other uses [7]. Here, the need to reuse it in other resources such as housing, in order to benefit from it again, emerged. This is an advantage of industrial buildings. For example, it is not possible to convert residential buildings into industrial or may require huge amounts of money, but the opposite can be made after making the
necessary adjustments, as industrial buildings have unique capabilities for adaptive reuse methods because of their large open sizes [8].

2.3. Barriers and challenges in Adaptive reuse of Industrial building

Silva and Perera presented a set of major barriers and challenges for adaptive reuse, as follows [9]:

- The space system design as the number of columns and walls.
- Building codes and conservation guidelines.
- The incompatibility of the new materials with the old ones in addition to the shortage of skilled workers.
- Lack of awareness about the importance of adaptive reuse, benefits and potential harm.
- Limited support from commercial property owners to make buildings sustainable or environmentally friendly.
- A lack of accurate information about the defects or the contradiction between them.
- The idea that reuse is a financially expensive method that requires double efforts.
- The challenges posed by the standards of development cities regarding the approach of urban renewal.

2.4. Industrial buildings in the Iraqi Ministry of Oil (research problem)

The restructuring of the economy is the result of the accelerated development in the local oil sector, as it is the main financier of the Iraqi budget (by 95%), to the transfer of industries from one area to another, in whole or in part, but due to the limited supply of vital lands and a large number of neglected buildings (after no longer needed) With a shortage of buildings, the concept of adaptive reuse has emerged as a non-traditional procedure with a major impact on the architectural decision-making process and then transforming it from a procedure into an actual, applied reality.

The research problem was determined by "knowledge deficiency in adaptive reuse determinants in neglected industrial buildings" and represented the aim of the research by identifying those determinants and showing their precedence in terms of use in neglected industrial buildings specifically affiliated with the Iraqi Ministry of Oil.

3. Research methodology

The research adopted a descriptive and analytical approach to achieving the goal, represented by the following steps:

- Review and analysis of studies specialized in an adaptive reuse of industrial buildings.
- Building a theoretical framework for the determinants of adaptive reuse and defining detailed indicators for each specific.
- Application by adopting the questionnaire for a group specialized in industrial buildings in the oil sector, to reach the results and conclusions of the research, as shown in figure 2.

![Figure 2. Illustration of the research methodology](image-url)
4. Previous studies of adaptive reuse in neglected industrial buildings

4.1. Ranking of Adaptive Reuse Strategies for Abandoned Industrial Heritage in Vulnerable Contexts: A Multiple Criteria Decision Aiding Approach:

The study indicates that in recent years, adaptive reuse has been adopted as a strategy to preserve cultural heritage. When using this strategy, it is not only about protecting buildings, but also historical and heritage significance, and the comparison between the adoption of symbolic values and the new uses become the utmost importance. Also, the study shows that in many cases, the decision-making is based on a set of multiple, conflicting and complex criteria. Therefore, the study suggests the importance of taking a multi-criteria approach to help in deciding to classify strategies for adaptive reuse of cultural heritage. Besides that, The study presents seven different alternative uses for adaptation, which are home, hotel, farm, office, museum, social and cultural center and the goal is to know the most appropriate of these buildings for the seven new uses, through a committee of experts including business leaders, practitioners in the field of real estate, heritage and tourism, Where they worked as a building management system [10].

We conclude that the study proposes the association of the heritage aspect with industrial buildings through adaptive reuse, in addition to the possibility of knowing the most suitable buildings for multiple uses by proposing criteria specific to each project.

4.2. Adaptive Reuse of Industrial Buildings for Sustainability; Analysis of Sustainability and Social Values of industrial Facades

The study indicated that adaptive reuse will transform existing outdated buildings into new styles with multiple uses that will play a fundamental role in strengthening local communities, as the industrial site can be transformed into another multi-use to produce new uses and increase the vitality of cities. Consequently, this method enables preserving its historical importance and providing new experimental spaces in urban areas, where these new buildings and sites are attractive to the public when they are combined with old structures that include new contemporary building Item and in harmony with it.

The study indicates that each industrial building contains different conditions for the site, building codes, conservation strategies, and surrounding areas. As a result, architects should appropriately consider different adaptive reuse strategies and implement them to achieve urban sustainability that sets their goals for their city [11].

We note from the above that the study emphasized the importance of activating adaptive reuse in industrial buildings to achieve sustainability within social values through the work of harmonious integration between the style of old and contemporary buildings with the need to study the determinants associated with this process.

4.3. The possibilities for conversion and adaptive reuse of industrial facilities into residential dwellings

The study indicates that the restructuring of the budget led to the cancellation of some activities, and this led to the emergence of a huge number of abandoned buildings and sites. These buildings characterize part of the neglected architectural heritage that can be used to form new residential areas in the same existing urban design. Converting these buildings into residential buildings can solve the problem of the interactive market and the shortage of housing.

The study analyzes the possibility of re-use of industrial facilities in residential housing, and how this transformation will be legitimate, by looking at a number of architectural conditions essential for the achievement of adaptive reuse to activate the function of the house, by analyzing the restrictions and advantages of industrial facilities and possible problems. The study suggests that through the process of adaptive alteration and reuse, the current industrial stock activation provides:

- Protecting the architectural and historical integrity of these buildings.
- Regenerate outdated areas.
- Reducing negative impacts on the environment and gaining positive results related to material resources and energy.

Then, the study raises several questions:
• Which industrial constructions are appropriate for residential buildings to reuse?
• What are the interventions that need to be taken to ensure that the appropriate housing quality is converted into an apartment building, the most important of which is the provision of capacity in the architectural space?
• What is the degree of interference to preserve architectural expression [12]?

We conclude that the study raised several item and questions for activating the industrial building to residential while preserving its architectural expressions, and the results that result in limiting the negative effects of the environment and acquiring new economic resources.

4.4. Revitalization of Industrial Buildings
This study explains the measures that some governments take to stimulate the redevelopment and transformation of old industrial buildings (activation measures), such as reducing sales taxes or the possibility of dropping or installment of fees paid to the state to change the effectiveness in industrial origin to other uses, while opening the fields of leasing industrial buildings for the purpose of investing at a fixed interest rate and making it less if it is a group. The study also focuses on the importance of having requirements for new specialization buildings, especially providing natural lighting and ventilation, for safety and health reasons to protect the safety of users. These requirements are related to the conversion work for use with modifications that may be superficial or substantial, or even the demolition of parts of the building in some, if not most, cases. Such works, even if technically feasible, may be expensive and will affect the viability of such buildings [13].

We note from the above that, the study focused on the importance of stimulating adaptive reuse by the responsible authorities, with the necessity to accompany them with the determinants and requirements related to the new use and explain their economic feasibility.

4.5. Aesthetics of industrial architecture in the situation of industrial Buildings conversion
The study discusses the aesthetic aspects of industrial architecture and provides a historical overview of industrial architecture development, in the form of giant buildings and complexes that are tightly woven with the urban matrix, as it suggests how to bring the aesthetics of industrial architecture close to modern humans and society, assuming that this relationship is one of the main factors necessary to revive and revitalize the old industrial properties.

The term "industrial aesthetics" can be defined as the intentional manifestation of structural and mechanical elements and finishes, in whole or in part, in a manner that enhances their aesthetic value. The study indicates that it is important to know that the value of these works is not only based on their technical and technical components but also derives from its memorial role, which achieves a state of selectivity for individuals with their surrounding context, unlike other areas of architecture that acquire these characteristics in their interesting forms. Here the term "industrial culture", which is one of the unique characteristics of special value, is highlighted by converting some of these buildings into heritage sites or for conservation that must be linked to space, region and date determinants [14]. We note that the study emphasized the importance of industrial aesthetics within the local context by deliberately highlighting the structural and mechanical elements and finishes that enhance the state of belonging and historical value, which must be linked to space, region, and history determinants.

We conclude from the previous studies that many detailed indicators of adaptive reuse in industrial buildings have emerged, so in the next axis a theoretical framework will be built to structure and reinforce these indicators additionally within the main Items representing the determinants that must be taken into consideration in the decision-making process of the architect of such buildings.

5. Determinants of adaptive reuse in neglected industrial buildings
For the success of adaptive reuse in industrial buildings, it is should be limitations that must be taken into account, the most important of which are the determinants associated with sustainability, ease of adaptation, location, neighbourhoods and general concerns, which will represent the vocabulary of the theoretical framework, as in the following sub-sections.
5.1. Achieving sustainability

Achieving economic viability is one of the most important determinants of successful adaptive reuse, as there are some hazards and doubts related to it, such as discovering underlying problems and defects that may be costly, or that capital investment is too high to meet current building regulations, such as safety Fires, which makes building owners not receive any economic benefit of upgrading buildings to meet sustainability determinants. But in general, it works to reduce costs by overcoming demolition, and here we must take into consideration, the age of the buildings and the quality of the building. As for the timeline, building from scratch takes longer to adaptive reuse, which sometimes may support occupancy before the project is completed. Besides, it may address the problem of urban sprawl to use existing lands instead of allocating new lands that may be expensive [15].

Compared to the construction of new buildings, the adaptive reuse of industrial buildings produces less waste and contributes to reducing the gases of the greenhouse, as it can contribute to improving the climate by reducing carbon dioxide emissions [16]. In addition, it may have a significant role in the sustainable development of societies, such as historical industrial buildings, which are well known in Europe, as these buildings may reflect the preservation of heritage that are related to the local communities to which they belong, their identity and affiliation. Also, the public interest may require confirmation of collective participation to obtain a consensus to support building adaptation and improvement of building use after conversion to preserve the local culture and consider how to incorporate new elements to it, which is also a challenge for designers [17] as shown in Figure 3.

![Figure 3. illustrates achieving sustainability in the adaptive reuse of industrial buildings](image1)

5.2. Ease of adaptation

Adaptive reuse indicates an alteration in the use of structures, and here the space planning must be evaluated in terms of the type of structural system, whether it is a structural system (columns and bridges), or load-bearing walls as in small workshop buildings, or open space buildings such as gables. In addition to the consideration that must be given to the functional change that occurs and the procedures it requires. For instance, not every façade of an industrial building contains windows which achieve the requirements of ventilation and lighting for residential purposes [18] as shown in figure 4.

![Figure 4. The possibility of adding ventilation and lighting openings in the industrial building to accommodate the new use.](image2)

In addition to the ability to add vertical and horizontal connections is an important treatment, because it is essential to afford many elevators and stairs due to the requirements of fire safety. For instance, the supreme distance between the furthest housing area and the evacuation ladder method should be 30 meters according to the regulations. Finally, there may sometimes be technological determinants that
are associated with the requirements of the style of the new building, the most important of which are mechanisms for adapting to the structural pattern and how to conform to the rules of practice and keep pace with innovative technologies, as shown in Figure 5.

![Figure 5](image1.png)

Figure 5. This shows the possibility of adding elevators and stairs in the industrial building to accommodate fire safety requirements

5.3. Location and neighborhood

The location of constructions has always been considered one of the vital determinants of building development with a new use. Private and public parking availability is necessary in some cases, as is the case in converting an industrial building into a residential one, where it is essential to afford a parking space for each housing component. The availability of open spaces may create a healthy environment for the exterior of the building, which will be reflected on the inside. As for public facilities and services, they are necessary to match the nature of the new use. One of the important things is to study the method of movement and the possibility of easy access and compatibility with the current environment in terms of the degree of association and neighbourhood status as shown in figure 6. For example, the former Wonder Bread factory in Washington retained its original connotations after redeveloping it into offices to achieve a formal linkage with neighbourhoods. In addition to public facilities and areas like parking, public parks, hospitals, and institutes should be planned in line with adaptive reuse plans. Here, the government should inspire plans that could make better use of the neighbourhood's existing public facilities [19].

![Figure 6](image2.png)

Figure 6. This illustrates the achieved formal state of association with neighbourhoods-Wonder Bread Factory.

5.4. General Interests

The inconsistent use of industrial buildings is the main concern for HSE determinants. For the protection of occupants, there should be evaluation procedures for adaptive reuse plans. Most industrial buildings may not meet the needs of occupants in providing a healthy environment that provides comfort, psychological and physical.

On the other hand, a set of legal and regulatory incentives must be emphasized in the process of converting industrial projects, such as changing the division of areas from “industrial” to “other” uses, and the accompanying adoption of required specifications and features such as LEED and BEAM. Besides, it is important to meet the requirements of the current building code and the accompanying tax procedures and facilities in the infrastructure of the project, as the industrial building may be eligible
for tax exemption from the state, or special funding and grants. It should be noted that changing the regulations is not easy and is subject to the approval of the competent higher authorities [20].

After the determinants of the success of adaptive reuse in neglected industrial buildings have been identified, the theoretical framework Item will be crystallized to arrive at major and minor Item and possible values, which are detailed in Table 1.

**Table 1.** Adaptive reuse Determinants in neglected industrial buildings

| Main Item                     | Secondary Item | Possible values                                      |
|-------------------------------|----------------|-----------------------------------------------------|
| Achieving sustainability      | Economic feasibility | Capital costs                                       |
|                               |                 | Age of construction                                 |
|                               |                 | Construction structure                              |
|                               |                 | Terminations                                        |
|                               |                 | timetable                                            |
|                               |                 | Cost of the life cycle                               |
|                               |                 | conserve Demolition and construction                 |
|                               |                 | Cost real estate                                     |
|                               |                 | Energy efficiency                                    |
|                               | Environmental impacts | Construction debris                                 |
|                               |                 | Noise                                                |
|                               |                 | Pollution                                            |
|                               | Social aspects  | Achieving development                               |
|                               |                 | Enhancing historical value                           |
|                               |                 | Conservation buildings                               |
|                               |                 | Heritage buildings                                   |
| Easy to adapt                 | structural aspect | Structural system                                   |
| Ease of adaptation            |                 | Bearing walls                                       |
|                               |                 | Open Space (Gable)                                  |
|                               | Functional aspect | Ventilation                                         |
|                               |                 | Lighting                                             |
|                               |                 | Complementary structural interventions               |
|                               |                 | Vertical transition                                  |
|                               |                 | Entrances and exits                                  |
|                               |                 | Supplements                                          |
| Location & neighborhood       | Site            | Parks                                               |
|                               |                 | Open spaces                                         |
|                               |                 | Public utilities                                     |
|                               | Easy access     | Public transport buses                               |
|                               |                 | Private buses                                        |
|                               | Compatibility with neighborhoods | Residential                                      |
|                               |                 | Industrial                                           |
|                               |                 | Other                                                |
|                               | Link grade      | Configurable                                         |
|                               |                 | Functional                                           |
|                               |                 | Contextual                                           |
| Public interests              | Health and Safety | Health and Safety Standards HSC                     |
| public interests              | Anxiety         |                                                     |
| Regulatory actions            | Legal proceedings |                                                     |
|                               | Tax measures    |                                                     |
|                               | Infrastructure facilities |                     |
6. Applied aspect
This aspect focuses on evaluating the determinants of adaptive reuse in neglected industrial buildings. This requires clarifying the basic requirements for it, applying to the selected samples, and discussing its results.

6.1. Basic requirements for practical study
The practical study relied on conducting a questionnaire for a group of engineers with experience in the oil sector (senior engineer - chief engineer) from the specializations related to industrial buildings in the Iraqi Ministry of Oil to show the most influential and effective determinants of adaptive reuse in neglected industrial buildings, to be a useful reference for different decision-makers for projects related to these buildings, see Appendix (1).

6.2. Application to samples
The results of the application showed the effectiveness of Achieving sustainability, as it showed achieving a high degree of importance from the Capital costs determinant, which constituted 65% of the total indicators of economic feasibility, followed by the Cost of life cycle determinant of 27%, so that each of the cost real estate and energy efficiency was limited to 11% and 2%, respectively. As for the environmental impacts, pollution achieved the highest importance rate with 55%, followed by Noise with 25% and finally Construction debris with 20%. Finally, in terms of social aspects, it scored the lowest, at 54% in the Enhancing historical value, compared to 46% in Achieving development, as shown in Figure 7.

![Figure 7. The variations of achieved sustainability ratios](image)

As for the single Ease of adaptation, the results showed about the structural aspect, outperforming Open Space, as it constituted 51% of the total indicators, followed by Cost of life cycle 44% while Bearing walls was limited to only 5% of the total importance of determinants. As for Functional aspect, it achieved Complementary structural interventions at 50%, while the Ventilation and Lighting parameters were 25% each., as shown in Figure 8.

![Figure 8. The variations of ease of adaptation ratios](image)
As for Location & neighborhood, the locator has emerged with 38%, followed by Open spaces with 32%, and finally, Public utilities with 30%. As for the Easy access term, the percentages were close to the importance of having public transport buses and private buses with 52% and 48%, respectively. Concerning compatibility with neighborhoods, the Industrial determinant was considered the most important in it by 55%, while the Residential determinant represented 25%, and the other aspects were limited to 20%. While Link grade Functional was 55%, Contextual side was 25%, and Configurable was 20, as shown in Figure 9.

![Figure 9. The variations of location & neighborhood ratios](image)

Finally, the Public interest’s term was extremely important for HSE at 46%, compared to Legal proceedings which accounted for 23%, and Infrastructure facilities which made up 18%, and tax measures did not exceed 12%, as shown in figure 9.

![Figure 9. The variations of location & neighbourhood ratios](image)

7. Conclusions

Several remarkable concluded points can be drawn from this study as follows:

- Within the concept of achieving sustainability in adaptive reuse, more attention is being paid to the economic and environmental side than the social aspect, due to the deficiency in the local reality in financial resources, especially capital costs, in addition to seeking to avoid or reduce any potential additional environmental damage within the oil Domestic sector.

- In terms of ease of adaptation, a state of complementarity emerged between the structural and functional sides, the ease and possibility of adding modifications and structural interventions depend on the flexibility of the structural structure in terms of deletion and addition, which was largely achieved in gables than in other structural buildings and with load-bearing walls. However, to reach the suitable quality of the design inside these transformed buildings, there is
a need that should be emerged to achieve a case of multiparity, by applying an "open concept", which is comparatively easy due to the huge size and structural systems adopted.

- Industrial buildings adoption encourages the use of local materials and it is necessary to retain the proportion of default internal and external building units and to conduct the design process in a manner that does not compete with origin building inherited with its proportions, figure, embodiment and location.

- Large industrial enterprises need to enter areas to move and connect vertically and horizontally. However, the establishment of these areas may affect the reduction of the usable area allocated to the new event. This situation can be addressed by building additional parts outside the building that would overcome this deficiency.

- It is necessary to study the nature of the determinants of the new building and compare it with the determinants on the site, the most important of which is taking into account the provision of public and private parking and easy access to the building.

- The new usage of industrial buildings depends on the internal quality and avoiding diseased environments as one of the main pillars of the occupants' concerns, the most prominent of which was the achievement of Health and Safety Standards, which is mainly related to providing ventilation and natural lighting.

8. Appendix
This appendix explains the measurement method used in the above research, through conducting a questionnaire for a group of engineers with experience in the oil sector (first engineer - chief engineer) from the specializations related to industrial buildings in the Iraqi Ministry of Oil to show the most effective determinants of adaptive reuse of neglected industrial buildings. To be a useful reference for different decision-makers for projects related to these buildings, it includes two paragraphs, the first includes a simplified explanation about the idea of research, and the second is the questionnaire form is presented for the purpose to collect data. This is shown in Figure A1 and Table A1.

![Figure A1. A questionnaire shows the most effective determinants of adaptive reuse of neglected industrial buildings](image-url)
| Table A1. This shows Value of evaluation of adaptive reuse determinants in neglected industrial buildings. |
|--------------------------------------------------|--------------------------------------------------|-----------------|-----------------|---------------|---------------|---------------|
| Main Item                                         | Secondary Item                                   | Possible values | Evaluative Degree |
| Achieving sustainability                         | Economic feasibility                             | Capital costs   | Very weak | Weak | Acceptable | Important | Very important |
|                                                  |                                                  | Age of construction | 5       | 11  | 14          |          |               |
|                                                  |                                                  | Construction structure | 2       | 11  | 17          |          |               |
|                                                  |                                                  | Terminations      | 2       | 13  | 14          |          |               |
|                                                  |                                                  | timetable         | 14      | 10  | 2           | 2       |               |
|                                                  |                                                  | conserve           | 2       | 10  | 13          |          |               |
|                                                  |                                                  | Demolition         | 1       | 7   | 14          | 7       |               |
|                                                  |                                                  | and construction  |          |      |             |          |               |
|                                                  | Environmental impacts                            | Cost of life cycle|          |      |             |          |               |
|                                                  |                                                  | Cost real estate  | 1       | 1   | 1           | 14      | 9            |
|                                                  |                                                  | Energy efficiency | 1       | 1   | 10          | 8       | 2            |
|                                                  |                                                  | Construction debris | 1     | 9   | 11          | 6       | 2            |
|                                                  |                                                  | Noise             | 2       | 3   | 11          | 8       | 2            |
|                                                  | Social aspects                                   | Pollution         | 1       | 2   | 5           | 8       | 14           |
|                                                  |                                                  | Enhancing         | 11      | 7   | 7           | 7       | 5            |
|                                                  |                                                  | historical value  | 1       | 12  | 10          | 5       | 2            |
|                                                  |                                                  | 1                 | 7       | 9   | 2           | 5       | 5            |
| Ease of adaptation                               | structural aspect                                | Structural system |          |      |             |          |               |
|                                                  |                                                  | Bearing walls     | 1       | 6   | 10          | 8       | 1            |
|                                                  |                                                  | Open Space (Gable)| 1       | 7   | 10          | 12      |               |
| Functional aspect                                | Complementary structural interventions           | Ventilation       |          |      |             |          |               |
|                                                  |                                                  | Lighting          | 2       | 5   | 12          | 11      |               |
|                                                  |                                                  | Vertical transition| 4     | 9   | 12          | 3       |               |
|                                                  |                                                  | Entrances and exits| 0    | 10  | 10          | 13      | 7            |
|                                                  |                                                  | Supplements       | 1       | 2   | 14          | 8       | 2            |
| Location & neighborhood                         | Site                                             | Parks             | 6       | 2   | 12          | 9       |               |
|                                                  |                                                  | Open spaces       | 2       | 10  | 12          | 6       |               |
|                                                  |                                                  | Public utilities  | 1       | 2   | 10          | 12      | 5            |
|                                                  | Easy access                                      | Public transport buses | 2     | 2   | 6           | 10      | 8            |
|                                                  |                                                  | Private buses     | 2       | 2   | 9           | 13      | 4            |
|                                                  | Compatibility with neighborhoods                 | Residential       | 11      | 7   | 7           | 5       |               |
|                                                  |                                                  | Industrial        | 10      | 5   | 8           | 7       |               |
|                                                  |                                                  | Other             | 5       | 10  | 8           | 6       | 1            |
|                                                  |                                                  | Configurable      | 9       | 8   | 9           | 2       | 1            |
|                                                  |                                                  | Functional        | 8       | 1   | 12          | 9       |               |
|                                                  |                                                  | Contextual        | 2       | 6   | 15          | 4       |               |
| Public interests                                 | Health and Safety Anxiety                       | Health and Safety Standards | 1     | 4   | 7           | 18      |               |
|                                                  | Regulatory actions                               | Legal proceedings | 10      | 5   | 8           | 5       |               |
|                                                  |                                                  | Tax measures      | 13      | 7   | 3           | 5       | 2            |
|                                                  |                                                  | Infrastructure facilities | 4     | 15  | 3           | 7       |               |
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