Methodology for assessment of repair and restoring potential of real estate

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Abstract. Buildings and structures, as complex technological objects ensuring the effective functioning of a number the urban development environment social processes, need periodically technical updating, conceptually viewed from the standpoint of expedient reconstruction. The respective budgets rational strategic and operational planning issues directed to the immovable complexes’ reconstruction should be considered from the standpoint of both technical and town-planning expediency of reconstruction determined by a number of the object key indicators of reconstruction forming its urban-planning reconstruction potential. Particularly acute is the reconstruction rationality quantitative assessment question when implementing the investment programs financed by municipal and federal budgets, in which the integrated reconstruction of the territory is most effective. The reconstruction resource intensity is made up of the territory individual objects local resources - interrelated territorial functions carriers. The methodological approaches and algorithms for constructing a quantitative assessment of the property repair and restoration potential can be an effective complement to methods of dynamic analysis and the urban planning potential effectiveness evaluation of the actively developed territories. The paper demonstrated the practical use examples of the proposed methodologies, proposed methodological approaches to their integration into practical software industry.

Introduction
The most important condition for economic efficiency and technological feasibility of real estate reconstruction is the availability and operability of an effective toolkit for dynamic analysis of the real estate objects subjected to potential reconstruction as part of modern industry software. The authors created a high-tech production “Develop new methods and tools for property management in the public sector and implement them in the software package of the information-analytical system for centralized management of property owned by constituent entities of the Russian Federation, municipalities, as well as property of state-owned companies” within the framework of work on a comprehensive project. It offers a comprehensive method for quantitative assessment of repair and restoration of real estate objects based on a complex analysis of urban planning and technical suitability of facilities for the technical improvements introduced by the reconstruction and repair of high-potential formalization and integration into modern digital property complex management environment.

Urban parameters (UP) have a great influence on the repair potential of buildings and structures, at the same time depend on a large number of factors. The urban planning suitability of a real estate, determined by a set of UPs, needs a quantitative expression, which allows it to be offered a single poly-criteria equivalent for a comparative analysis of objects within the reconstructed urban planning
environment. Such urban planning parameters of buildings, \( \text{UP}_i \) as the surrounding area infrastructure saturation location, transport accessibility, population density (users of the potential object of reconstruction), accessibility of the object for the target audience of users, and the territory Technosphere safety are used to analyze the urban planning suitability. The real estate urban development parameters nomenclature expansion, if necessary to take into account the current urban development situation or targeted program indicators of the village territorial development, is done similarly without changing the overall assessment algorithm.

In order to provide the buildings urban development potential comparative assessment with a wide range of \( \text{UP}_s \), a method for the private assessment of individual \( \text{UP}_i \) was proposed on a three-point scale from 1 (the \( \text{UP} \) best matches the objectives and resource productivity of the potential reconstruction) to 3 (the worst match) (Table 1).

**Table 1.** Main urban parameters, \( \text{UP}_s \), and evaluation of the urban development potential of real estate reconstruction in terms of:

| Town planning parameters | Evaluation of the urban development potential of real estate reconstruction in terms of indicators |
|--------------------------|--------------------------------------------------------------------------------------------------|
| **\( \text{UP}_1 \). Location** | 3 points - central districts of the microdistrict, quarter 2 points - marginal areas of the microdistrict 1 point - outlying areas of the city |
| **\( \text{UP}_2 \). Infrastructure saturation of the environment** | 3 points - on foot (0.5 km) accessibility to main infrastructure facilities (parking, driveways, social welfare facilities, healthcare facilities) 2 points - (1.5 km) accessibility to major infrastructure facilities (parking, driveways, social welfare facilities, healthcare facilities) 1 point - transport (3.0 km) accessibility to major infrastructure facilities (parking, driveways, social welfare facilities, healthcare facilities) |
| **\( \text{UP}_3 \). Transport accessibility** | 3 points - the presence of the urban transport route network (stops within walking distance - at least 3), the presence of city roads (at least 2), the average workload of access roads during the planned operation of the object (online cartographic services) 2 points - the presence of the urban transport route network (stops within walking distance - at least 2), the presence of urban highways (at least 1), the average workload of access roads during the planned operation of the object (online cartographic services) 1 point - the presence of the urban transport route network (stops within walking distance - 1 or less), the average workload of access roads during the planned operation of the object (online map services) |
| **\( \text{UP}_4 \). Population density** | 3 points - population density of the territory within walking distance (circle with a radius of 500 m), 10,000 people and more 2 points - the population density of the territory is accessible (circle with a radius of 500 m), 5,000 people and more 1 point - population density of the territory within walking distance (circle with a radius of 500 m), 1000 people and more |
| **\( \text{UP}_5 \). Availability of the target audience** | 3 points - percentage of residential real estate in the total real estate of the territory within walking distance (circle with a radius of 500 m), 75% or more 2 points - percentage of residential real estate in the total real estate area within walking distance (circle with a radius of 500 m), 60% or more (online map services) 1 point - percentage of residential real estate in the total real estate area within walking distance (circle with a radius of 500 m), 40% or more |
Town planning parameters | Evaluation of the urban development potential of real estate reconstruction in terms of indicators
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more (online map services) | (online cartographic services)

UP6. Technosphere safety of the territory
- 3 points - remoteness of the location of Technosphere hazard objects (GTR) within walking distance (circle with a radius of 500 m), pieces, less than 2: gas stations, garage arrays, open parking lots, organized and unorganized landfills, industrial facilities, warehouses, large shopping facilities (more than 2000 m2), etc.
- 2 points - less than 5 GRT walking distance
- 1 point - less than 10 GRT walking distance

The UPi significance in the integral assessment of the potential based on them is determined by the quantitative specific weights of the indicators ki determined by ranking them according to the Fishburn rule (Table 2).

Table 2. Ranking technological suitability indicators of real estate for reconstruction

| Indicator TSi | Grade | Specific gravity ki |
|---------------|-------|---------------------|
| UP1. Location | 4     | 0.19                |
| UP2. Infrastructure saturation of the environment | 2     | 0.10                |
| UP3. Transport accessibility | 1     | 0.05                |
| UP4. Population density | 3     | 0.14                |
| UP5. Availability of the target audience | 5     | 0.24                |
| UP6. Technosphere safety of the territory | 6     | 0.29                |
| Total         | 21    | 1.00                |

The integral assessment of the urban planning potential (IAUP) of the real estate object reconstruction is carried out taking into account the private estimates of its UPi and their specific weights (Table 3).

IAUP = (UPi, ki).

The results of the IAUP made in 2019 for individual public buildings of similar functional purpose and constructive solution that are on the balance of the Belgorod municipality in 2019 in various territorial locations are presented in Table. 3

Table 3. An example of an integrated assessment of the different territorial locations similar functional purpose real estate objects reconstruction potential urban development

| Object name | Urban parameter, UPi | Parameter value, point | The parameter proportion , ki | Private rating UPi, point |
|-------------|----------------------|------------------------|-----------------------------|--------------------------|
| Building №1 | UP1                  | 3                      | 0.19                        | 0.57                     |
|             | UP2                  | 3                      | 0.10                        | 0.29                     |
For the qualitative boundaries categorization and the volatility obtained in a practical analysis of real buildings, IAUP proposes to use spectral filtering with a mark of marginal objects (the urban planning potential of the reconstruction of which is empirically rated most and least highly). The actual boundaries of the IAUP from 2.19 to 2.62, obtained in the example table 3, allow to establish the following categories of technological suitability:

| Category of urban planning potential of IAUP |
|---------------------------------------------|
| suitable                                    | 2.7 and more |
| unsuitable                                  | 2.3 ... 2.6  |
| unsuitable                                  | 2.2 or less  |

The presented method of obtaining the real estate objects IAUP establishes the relative comparative significance of the individual immovable objects town-planning reconstruction potentials, which makes it possible to effectively complement with this assessment existing and improved methods for analyzing the resource efficiency of the potential reconstruction of the object. The authors previously reviewed the methodological approaches and quantitative algorithms for assessing the technological suitability (ATS) of the property for reconstruction, which determines the feasibility of such in terms of specific design solutions and the technical condition of the building [1, 2]. In this regard, it is proposed to summarize both assessments — the town-planning potential and technological suitability — into a single integral assessment of the repair and restoration potential (RRP), which becomes a relevant indicator of potential resource intensity and the feasibility indicator of financing the device for technical improvements of the property by reconstruction and repair in terms of its current technical condition and taking into account the object location. In the initial approximation, the weight averaging of the ATS and IAUP is performed with specific gravities of 0.45 and 0.55, respectively (Table 4).
Table 4. Evaluation of the repair and restoration potential of individual social and cultural facilities subordinate to and funded by the capital construction management of the Belgorod District Administration in 2019

| Object       | ATS, points | IAUP, points | ATS normalized | IAUP normalized | ERRP |
|--------------|-------------|--------------|----------------|-----------------|------|
| Building №1  | 7.01        | 2.57         | 0.28           | 0.26            | 0.268|
| Building №2  | 6.22        | 2.62         | 0.25           | 0.26            | 0.257|
| Building №3  | 5.97        | 2.19         | 0.24           | 0.22            | 0.229|
| Building №4  | 5.77        | 2.57         | 0.23           | 0.26            | 0.246|
| Total        | 24.96       | 9.95         | 1.00           | 1.00            | 1.000|

The aggregate amount of financing for the development of real estate objects (mainly social, cultural and educational purposes) on the balance of municipal and federal budgets makes up a significant share of the state infrastructure expenditures. Thus, according to [3], only 4.7 billion rubles were allocated for the educational facilities construction and reconstruction in 2018 in the Belgorod Region, in 2019–2020. It is planned to allocate another 7.5 billion rubles, of which at least 10% is direct financing of the reconstruction. At the same time, practical methods of object-based distribution of allocated funds are still not sufficiently formalized and analytically quantitatively provided, which reduces the potential resource returns of investments and the overall effectiveness of centralized management of property, especially in state ownership.

To provide the instrumental support for making rational management decisions in the above issues, the authors propose a qualitative scale of the categories of the repair and restoration potential of real estate objects, which is spectral filtering for marginal objects whose ERRP s are empirically rated most and least high, with specific gravities for ATS and IAUP 0.45 and 0.55, respectively (Table 5).

Table 5. Qualitative scale of the ERRP facilities potentially reconstructed real estate

| Category of repair potential | ATS, limits | ATS normalized, limits | IAUP, limits | IAUP normalized, limits | ERRP |
|------------------------------|-------------|------------------------|--------------|-------------------------|------|
| unusable                     | 2.0         | 0.27                   | 7.2          | 0.31                    | 0.29 and less |
| indecent                     | 2.1-2.6     | 0.28-0.36              | 7.3-8.8      | 0.32-0.37               | 0.30-0.37 |
| usable                       | 2.7         | 0.37                   | 8.9          | 0.38                    | 0.38 and more |

The practical result of the ERRP dynamic analysis, which is interpretively suitable for incorporation into effective management decision-making algorithms for strategic and operational planning for effective budgeting of their technical improvements, repair / reconstruction is the color classification of objects in relation to their current location, complementing modern cartographic services (Figure 1). The traditional traffic control software repair and restoration potential categories reflection for the software will automate the overall express assessment of the territory, focusing the manager’s attention on global areas of effective reconstruction provided by green facilities. Real estate objects that fall into the yellow and red zones exhaust or have already exhausted the economically, technologically and territorially effective potential of reconstruction and, most likely, will be planned for a complete replacement [4, 5].

The presented method of quantitative ranking of immovable objects in terms of integral repair and restoration potential allows enriching analyst’s tools in the field of building management and operation with an practically effective tool for rational budgeting of municipal and federal immovable funds, and
the real estate management techniques will allow to more actively formalize, acquire digital implementation and integrate into modern software used in the current practice of real estate property management for various purposes, and industry sector.

![Figure 1. Visual classification of real estate based on the dynamic calculation results of their ERRP (for example, non-commercial objects of a certain category, localized in the Belgorod region)](image)

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