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Technology for Assessing the Efficiency of Housing Fund Reproduction

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***Abstract*: In the article, the author presents an original technology for assessing the efficiency of housing fund reproduction. According to the presented methodology, the author suggests assessing the efficiency of housing fund reproduction based on two aspects: first, the indicator of condition, which is an integral indicator determined based on a group of aggregated indicators related to main directions of housing market development; second, the indicator of dynamics – a growth coefficient calculated as a geometric mean of growth coefficients in social, technical, investment and market indicators.**

To interpret and visualize obtained data concerning integral indicators assessing the efficiency of housing fund reproduction, the author has upgraded the Harrington scale by supplementing it with values of the reviewed ranges of the average growth coefficient, which characterizes the pace of housing fund reproduction. This upgrade has allowed the author to transform the scale into a two-dimensional matrix and to highlight efficiency areas in it, namely high, above-average, below-average and low, which are recommended for the assessment of reproductive activities on federal, regional and municipal levels. The visualization has helped the author build a development trajectory for housing fund reproduction within certain chronological frames based on the aggregate of objects under study.

***Keywords*: housing fund reproduction, integral indicator for assessing the efficiency, dynamics of housing fund reproduction, assessment matrix.**

I. INTRODUCTION

Housing fund reproduction is one of the key state policy objectives. In most European countries and Russia, an increase in the pace of commissioning of residential facilities is observed [1-4]. The main purpose of housing fund reproduction is to satisfy the need for residential facilities, which meet modern requirements, including in terms of environmental safety and energy efficiency [5-7], as well as to prevent early depreciation and maintain technical, operating and consumer properties of housing. The aforementioned circumstances show that it is reasonable and important to assess the efficiency of housing fund reproduction in order to subsequently extrapolate positive results and benchmark the most efficient managerial strategies.

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II. PROPOSED METHODOLOGY

A. General description

The assessment of the efficiency of housing fund reproduction as a dynamic system, which develops incessantly and is in complex interaction with other sub-systems [8, p. 7; 9, p. 11] on federal, regional and municipal levels, provides for the consistent implementation of four stages (Figure 1).

B. Algorithm

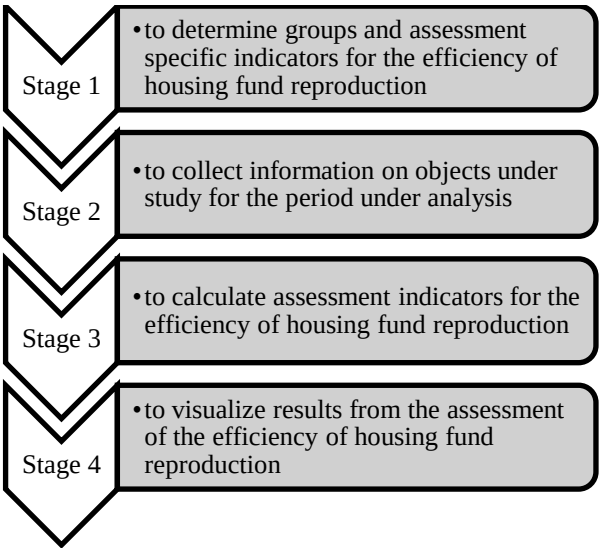

Fig. 1: Stages of assessing the efficiency of housing fund reproduction.

Given the aforementioned stages, we developed a comprehensive method for assessing the efficiency of housing fund reproduction on federal, regional and municipal levels, which takes into account the intensiveness of qualitative changes and can be visualized, making it possible to compare and assess housing fund reproduction in certain chronological frames based on the aggregate of objects.

III. RESULT ANALYSIS

Specific indicators introduced in various methodologies [1, 2, 3, 9-14], taken individually, do not sufficiently present the assessment of the efficiency of housing fund reproduction. In this case, an integral indicator, being a unified criterion for comparison, allows one to perform a comprehensive assessment.

The integral indicator for the assessment of the efficiency of housing fund reproduction can be determined based on the methodology described in [15] (Figure 2).

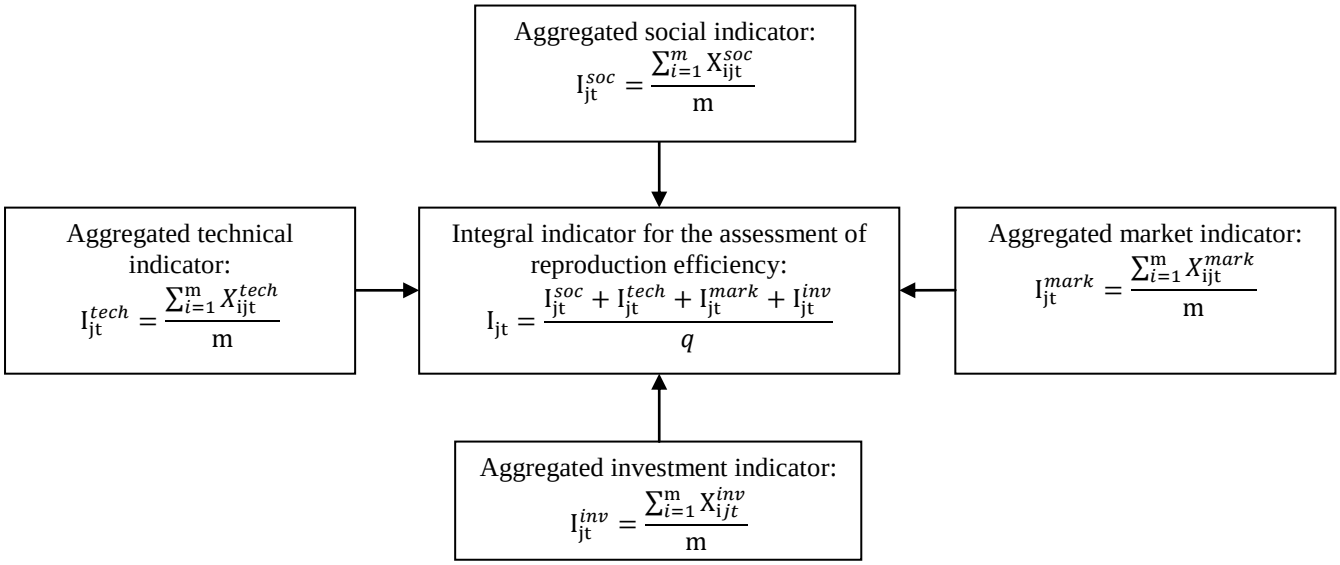

Fig. 2: Components of the integral indicator for the assessment of the efficiency of housing fund reproduction.

The integral indicator for the assessment of the efficiency of housing fund reproduction allows us to perform an assessment in terms of statics without taking note of positive/negative changes in a constituent entity's development trends. However, we think that it is correct to assess not only the current situation but also the nature of changes seen in a constituent entity's housing sector. A region, as a whole, can show average numbers for housing fund reproduction but if these indicators show some signs of stagnation or degradation, a negative trend, which is timely identified in the course of the assessment, can be prevented.

Let us specify indicators characterizing the dynamics of housing fund reproduction using relative figures (growth coefficients). To take into account the direction of the influence of growth coefficients, it is necessary to determine negative indicators as reciprocal numbers.

In terms of assessment directions, average growth coefficients can be found with the help of the geometric mean, which is a specific indicator of a non-linear multi-factor function (of the power type) (Figure 3).

The average growth coefficient, which characterizes the dynamics of housing fund reproduction, can be found by the consistent calculation of average growth coefficients for indicators, which make up the system.

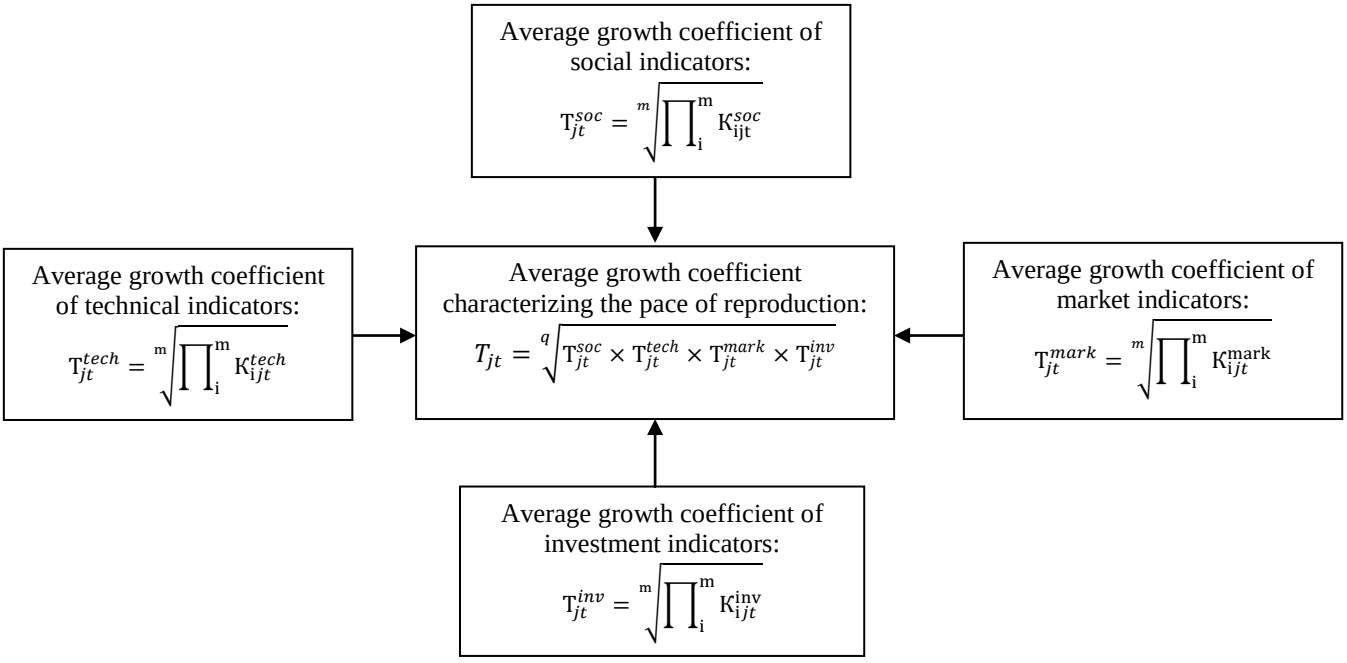

Fig. 3: Components of the average growth coefficient characterizing the dynamics of housing fund reproduction.

The complicated nature of housing fund [8, p. 7; 9, p. 11] makes it necessary to assess jointly both indicators of condition and dynamics, allowing us to assess tendencies in housing fund development.

We suggest performing such a comprehensive assessment on the basis of a matrix with the horizontal axis showing a value of the integral indicator of efficiency assessment and the vertical axis showing a value of the average growth coefficient characterizing the dynamics of housing fund reproduction (Figure 4).

To interpret obtained numbers for the integral indicator of assessment of the efficiency of housing fund reproduction, let us upgrade the Harrington scale [16, p. 150], values of which are marked on the horizontal axis of the efficiency assessment matrix (Figure 4).

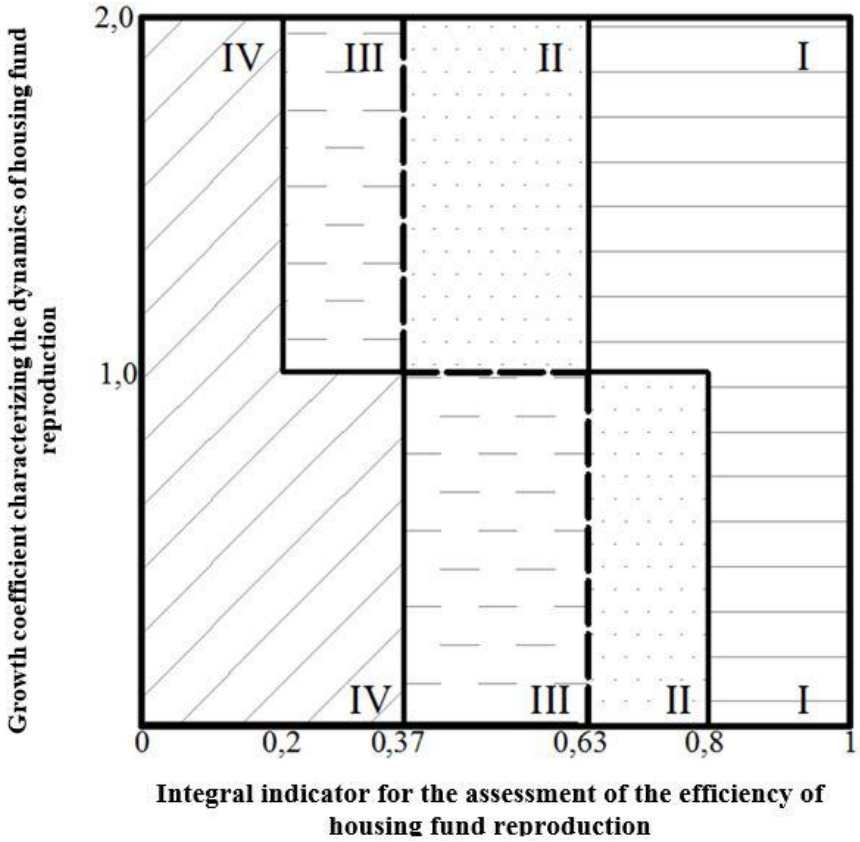

Fig. 4. Matrix for the assessment of the efficiency of housing fund reproduction.

The integral indicator for the assessment of the efficiency of housing fund reproduction ranges from 0 to 1. The growth coefficient can change within a broader range but, for successful reproduction, the growth coefficient must not be under 1. A combination of estimates of these two indicators makes it possible to mark several efficiency areas on the matrix and characterize reproduction in a constituent entity under study.

Sector I:

Housing fund reproduction will show the highest efficiency if the integral indicator for the assessment of the efficiency is higher than 0.8, which corresponds to the mark "very high" on the Harrington scale [16], and the indicator of the growth coefficient characterizes positive dynamics, which corresponds to the condition (1):

$$\begin{cases} I_t \geq 0.8 \\ K_t > 1 \end{cases} \quad (1)$$

If housing sector conditions are favorable and the efficiency of housing fund reproduction is high, resources, as a rule, are redistributed into other sectors, which can slow down the pace of housing fund reproduction indicators. The slowdown of growth coefficients in the short term will not impact the efficiency of reproduction. For this reason, if the condition is (2) the efficiency of housing fund reproduction is also high:

$$\begin{cases} I_t \geq 0.8 \\ K_t \leq 1 \end{cases} \quad (2)$$

Measures aimed to develop housing fund reproduction have a deferred effect. For this reason, if during the current period indicators of dynamics are higher than in the past period, in case of favorable circumstances, the result reflected in the integral indicator will rise. Thus, let us formulate another condition (3), under which the assessment of reproduction efficiency will be high:

$$\begin{cases} I_t \geq 0.63 \\ K_t > 1 \end{cases} \quad (3)$$

Let us generalize terms for high assessment of the efficiency of housing fund reproduction (4):

$$\begin{cases} I_t \geq 0.8 \\ K_t \leq 1 \end{cases} \vee \begin{cases} I_t \geq 0.63 \\ K_t > 1 \end{cases} \quad (4)$$

This condition corresponds to Sector I in Figure 4.

If the trajectory of indicators for the assessment of the efficiency of housing fund reproduction during the period under analysis is seen in Sector I, then the assessment of reproduction efficiency of a constituent entity under review is high and the reproduction policy is balanced. A strategic goal to be pursued by the constituent entity under review should be to maintain reproduction up to the mark.

Sector II:

Housing fund reproduction is sensitive to a wide range of factors. Socio-economic crises, shortfalls in funding and reforms in the public utility sector influence the efficiency of housing fund reproduction directly and indirectly.

If growth numbers decrease during the current period, then the efficiency of housing fund reproduction should be expected to decrease in the long term.

It is easy to track the influence of dynamics indicators on those of condition. For example, such an indicator as the average housing provision coefficient depends on the pace of housing commissioning through all forms of reproduction, including renovation and major repair. The average home provision coefficient per capita is a sort of standard for a person's welfare in the housing sector. The coefficient's growth is associated with new construction, renovation and major repair of residential facilities. Higher housing fund commissioning through all forms of reproduction also influences a number of technical indicators. The higher the commissioning, the higher the specific weight of residential space equipped with main engineering systems and the lower the specific weight of old and breakdown housing. The fewer funds are invested in reproduction, the lower are the commissioning and the availability of housing, etc.

Thus, stagnation and slowdown incessantly lead to lower efficiency of reproduction. In the first place, slower reproduction is caused by insufficient funding in this sector, absence of a favorable investment climate, as well as unbalanced supply and demand in the real estate market.

The condition, under which the efficiency of housing fund reproduction can be assessed as "above average", is shown below (5):

$$\begin{cases} 0.63 \le I_t < 0.8 \\ K_t \le 1 \end{cases} \vee \begin{cases} 0.37 \le I_t < 0.63 \\ K_t > 1 \end{cases} \quad (5)$$

This condition corresponds to Sector II in Figure 4.

Sector II is characterized by the moderately high integral indicator of efficiency assessment. In this case, the efficiency of the reproduction policy can be assessed as above average.

At this level of the efficiency of housing fund reproduction, it is important to preserve obtained results and to make effort to develop current regional and municipal programs pertaining to housing reproduction, as well as to introduce innovation and reforms in the public utility sector.

Sector III:

The condition, under which the efficiency of housing fund reproduction can be assessed as "below average", is shown below (6):

$$\begin{cases} 0.37 \le I_t < 0.63 \\ K_t \le 1 \end{cases} \vee \begin{cases} 0.2 \le I_t < 0.37 \\ K_t > 1 \end{cases} \quad (6)$$

This condition corresponds to Sector III in Figure 4.

Sector III is characterized by a relatively low value of the integral indicator of assessment of the efficiency. In this case, the reproduction policy is inefficient.

Low indicators of the assessment of the efficiency are associated with a general lag in a region's development and the absence of progress in the housing sector.

Sector IV:

If the trajectory of indicators for the assessment of the efficiency is seen mostly in Sector IV, it can be said that the condition is unfavorable and the efficiency of housing fund reproduction is low. A formalized condition is as follows (7):

$$\begin{cases} 0 \le I_t < 0.37 \\ K_t \le 1 \end{cases} \vee \begin{cases} 0 \le I_t < 0.2 \\ K_t > 1 \end{cases} \quad (7)$$

This condition corresponds to Sector IV in Figure 4.

The location in Sector IV is the most unfavorable. Sector IV is characterized by the low integral indicator of the assessment of the efficiency. These results from the assessment of the efficiency of reproduction are a sign of a substantial lag in the development of the constituent entity under review. It is difficult to solve the current problems, therefore, it is necessary to draw subsidies from the federal budget and to elaborate new programs aimed to improve the reproduction policy.

Let us show possible indicators for the assessment of the efficiency of housing fund reproduction in Table 1.

Table 1: Criteria for the assessment of the efficiency of housing fund reproduction.

Assessment of the efficiency	Condition	Location in the matrix
High	$\begin{cases} I_t \ge 0.8 \\ K_t \le 1 \end{cases} \bigvee \begin{cases} I_t \ge 0.63 \\ K_t > 1 \end{cases}$	Sector I
Above average	$\begin{cases} 0.63 \le I_t < 0.8 \\ K_t \le 1 \end{cases} \bigvee \begin{cases} 0.37 \le I_t < 0 \\ K_t > 1 \end{cases}$	Sector II
Below average	$\begin{cases} 0.37 \le I_t < 0.63 \\ K_t \le 1 \end{cases} \bigvee \begin{cases} 0.2 \le I_t < 0. \\ K_t > 1 \end{cases}$	Sector III
Low	$\begin{cases} 0 \le I_t < 0.37 \\ K_t \le 1 \end{cases} \bigvee \begin{cases} 0 \le I_t < 0.2 \\ K_t > 1 \end{cases}$	Sector IV

The location in several adjacent sectors is presented in Figure 5.

Upon assessment of the efficiency, the results can be shown in several adjacent sectors. This is a sign of an inconsistent reproduction policy and of the influence of external factors, which impact the housing policy.

If by the end of the period under analysis assessment indicators are in the most favorable sector (Sector I), then efforts to maintain the specified course should be selected as a strategic direction. If the sector is less favorable (Sectors II, III, IV), it is necessary to take the relevant measures to improve those indicators, which dampen the overall assessment of the efficiency.

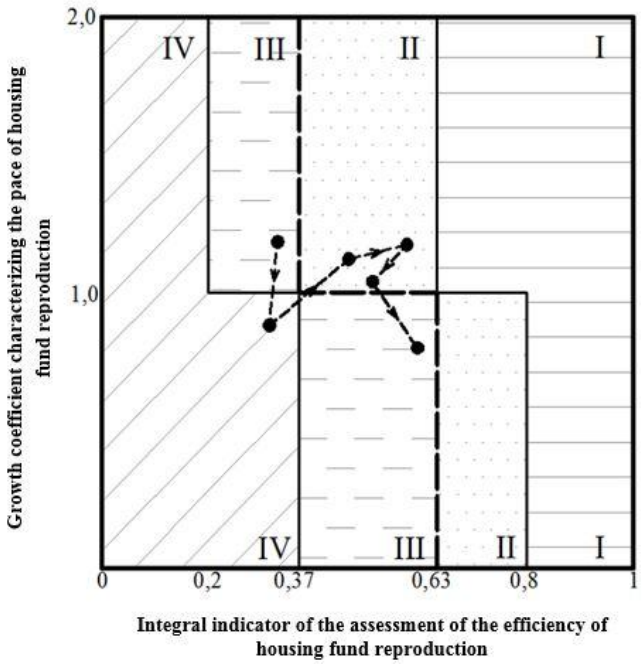

Fig. 5: Location of the housing fund reproduction trajectory in several adjacent sectors.

IV. DISCUSSION

Many scholars are engaged in assessing the efficiency of housing fund reproduction but it should be noted that there is no unified generally accepted method of assessment. To assess the efficiency of housing fund reproduction in the Russian housing policy, a modest set of indicators, such as the share of old and breakdown residential facilities, total residential space per person, share of commissioned housing and share of well-equipped housing, is applied [16, 17, pp. 9-14].

One of the key aspects in housing fund assessment in Europe is the presence of a sufficient amount of space in a home. This aspect is measured by the overcrowding coefficient, i.e. the share of people living in an overcrowded home. The reproduction policy in European countries is also assessed based on home availability. The housing fund quality is reflected in the deprivation coefficient, its inability to fully meet a person's housing needs [18].

In Great Britain, housing conditions have been assessed for 50 years already in terms of technical condition and tenant satisfaction, as commissioned by the Ministry of Housing, Communities and Local Government. The assessment targets both physical deterioration of housing, as well as accomplishment and compliance with modern energy efficiency requirements [19].

Systems of indicators are applied to assess housing fund reproduction in various countries. In their works, many authors offer upgraded methodologies based on a wide range of indicators [9-14]. Such methods, as a rule, are simple but it is difficult to assess the housing fund using them; given an aggregate of individual indicators, it is possible to make a conclusion about the efficiency of housing fund reproduction as a whole.

Using methods based on the definition of a single efficiency criterion [20-23], (as a rule, an integral indicator) it is quite easy to perform a comprehensive comparative assessment of constituent entities and periods. However, these methods have some drawbacks, such as the lack of a base for comparison and visualization of results associated the assessment of the efficiency of housing fund reproduction. The methods are labor-intensive and calculation requires the processing of a big set of data because some methods [22, 23] include up to 80 indicators. In addition, the indicators include both absolute values and growth rates (coefficients) and this, as we believe, is not quite correct. It is evident that growth rates can be positive but absolute values, based on which they are calculated, are far from desirable. Thus, this can result in the distortion in the general assessment of the efficiency of housing fund reproduction. In our opinion, it is fairer to assess the efficiency of housing fund reproduction based on two aspects: indicators of condition characterizing housing fund reproduction during a period under analysis and indicators of dynamics reflecting the pace of change in indicators of condition.

V. CONCLUSION

We propose a technology that aims to conduct a comprehensive assessment of the efficiency of housing fund reproduction based on two aspects: indicators of condition characterizing housing fund reproduction during a period under analysis and indicators of dynamics reflecting the pace of change in the indicators of condition. On an integrated basis, these indicators are not taken into account in available instruments, which does not allow assessing the efficiency of housing fund reproduction in the past in a chronological frame on regional, federal and municipal levels. The presented method was supplemented by an original approach to graphic visualization of results of the assessment of the efficiency of housing fund reproduction and its development trajectory within the developed two-dimensional matrix based on the supplemented Harrington scale.

The method can be upgraded for the application on federal, regional and municipal levels and the list of indicators can be broadened or narrowed.

Chronological frames can be determined in accordance with the goals of assessment, e.g. to assess a new housing policy (timeframes are tied to a date, on which the new policy is introduced) or to assess post-crisis recovery (starting point of assessment corresponds to a crisis period), etc. Data obtained in the course of assessment can be used for benchmarking [24], rating compilation, formation of housing programs and development of roadmaps for constituent entities.

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