Building energy modeling as a mandatory requirement of cooperative housing projects

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Abstract. Energy modeling of buildings reduces sales risks in the sense that it contributes to expanding the spheres of business, hi-tech production, innovations and information telecommunication technologies, improve the state of the environment. Until recently, the risks of “equity holders” were quite high despite the insurance system and bankruptcy procedure in accordance with the federal law. The process of cooperative housing projects did not prevent from frankly fraudulent schemes. Regulatory authorities have established strict requirements for the legitimate use of homebuyer’s assets, having formed the interaction with developers in electronic format. Among the pressing issues of organization and management of construction, one of the most significant is the problem of shared housing construction and efficient pricing management since the strategic approach of urban development and housing and utilities infrastructure depends on its decision. Depending on the problems facing a developer at various stages of its activity, the assessment of its reliability seems to be the most controversial. The tendency towards the destruction of the institutional fundamentals of housing was clearly marked; the implementation of most housing projects has been questioned. The system of standards for energy modeling allows the use of data for optimal pricing in order to avoid risks and harmonize relations between developers and shareholders at an early stage of the project. Building energy modeling as a mandatory requirement of cooperative housing projects are aimed at the construction of eco-friendly, economically- and energy-efficient buildings and entire districts convenient for living with the use of biopositive architectural and planning design concepts.

1. Introduction
As a result of the institutional adjustment of the economic and legal field, the legislation changes that came into force after July 1, 2018, significantly reduced the risks of “equity holders” at the facilities being put on the market. So, in particular, in accordance with Federal Law N304-FZ dated 03.07.2016 on participation in shared-equity construction projects of apartment buildings and other real estate objects, the authorized bodies are endowed with additional supervisory functions: approve the form of design documentation, the form and procedure for reporting by construction companies, etc. Developers shall obtain conformance; they shall not be included in the registers of unscrupulous suppliers, contractors, performers; the head and chief accountant of the firm must confirm the clean record for economic crimes. The new version of the design declaration contains the requirement for the full payment of the authorized capital to be sent further to the authorized (supervisory) authorities.
The requirements for the registered capital of developers have increased: the company must have a guarantee of banks and the payment of 10% of the funds (they will be stored in an authorized bank until the construction is completed).

Obviously, the problems of defrauded equity holders have passed a serious institutional study. However, certain provisions of this law, as a group of researchers believes, destroy the institutional foundations of housing construction and block the implementation of most investment and construction projects in the housing sector [1]. In practice, this law may cause unintentional bankruptcy and subsequent liquidation of most developers, a reduction in housing commissioning and a significant increase in its value; mass reduction of workers in construction organizations, disruption of the implementation of federal, regional and municipal housing programs [2–4]. “Drawing” of rights over to one of the parties to the agreement (developers or equity holders) does not lead to sustainable development of the construction industry [5-6]. In addition, in case of civil liability insurance of the developer, there is a possibility of rising prices for cooperative housing projects. In this regard, it is proposed to introduce compulsory insurance in the implementation of construction activities with the direct participation of the state in the form of the development of respective regulations and insurance [7]. In this case, there may be abuses by developers, in particular, fictitious bankruptcy and fraud. Although there is a register of unscrupulous developers, contractors, suppliers, it is nevertheless problematic to judge the scrupulousness of contracts implementation, considering the specifics of the budget sphere and the length of the legal procedures of contracts termination. There is also the practice of additional agreements, postponing and even falsification of documents [8-9]. All this suggests that the effectiveness of the procedures for placing construction orders in the Russian Federation is considered a more significant factor than the efficiency, scrupulousness, and reliability of their implementation [10].

A number of authors talk of the complexity of the mechanism for implementation of liability insurance of developers and the disadvantage for developers fulfilling their obligations to participate in a society of mutual insurance of civil liability of developers, therefore this type of liability insurance is in low demand. The most widespread is the liability insurance of developers by commercial insurance companies, which can be explained by the lower cost and the faster procedure for entering into insurance contracts. However, in view of high risks, commercial insurance is unreliable: as a rule, it does not have the organization of reinsurance protection for developers' liability insurance. Although the legislation suggests the state guarantees, their right to use is not enough to create a reliable reinsurance system. The adjustment of the legislation on cooperative housing projects in 2018 in principle did not affect the situation when a person who actually violated the rules of commercial insurance may evade responsibility. Practically, developers do not use the guarantee of a credit institution due to the lack of offers and high cost [11]. It is even more difficult to demand compensation for damage to life or health if housing has been commissioned, but for some reason the structure collapsed. In this case, it is necessary to find cause-effect relations to determine the actions of the developer, contractor, designer, building user, which led to the occurrence of harm, and provide the appropriate inspections. But there always remains the possibility for incorrect establishing of the collapse causes. It is no less difficult to identify a cause-effect relations between property damage that has occurred and performed construction activities if the building located near the construction site turned out to be deformed due to the dynamic load [12]. All the above mentioned factors prevent the optimization of construction activities and liability insurance. But both the strategic direction of urban development and housing and utilities infrastructure, and the pace of movement towards sustainable development of the country depend on the solution of this problem [13–16].

2. Materials and Methods
To create a conceptual model, a functional approach is applied that provides for a formal basis for the synthesis of system components. This approach makes it possible to simulate each main component of the system and integrate them into a single complex according to the structure of the conceptual model. The cumulative results of the qualitative analysis and quantitative characteristics of the system
are correctly analyzed using the qualimetric method associated with the development of principles for forming generalized quality indicators and substantiating the conditions for their use. In an effort to answer the question about the developer reliability, the authors raise the question of a set of properties of all system elements that determine its integrated ability to perform the specified functions in conditions of the changing external and internal environment, while maintaining their basic parameters within the specified limits. Therefore, based on the study of the problem of determining, assessing, and managing the reliability quality, as well as considering the objectives currently facing developers under the reforming the legislation on cooperative housing projects, this paper proposes the following approach to this problem:

- the process and the results of assessing the reliability of developer activities reflect the effect of changes in each factor on the ability to achieve strategic goals, solve tasks, the organization's resistance to changes in external and internal factors affecting its activities;
- in this regard, the criterion of economic reliability of the organization shall be a key factor in assessing the economic reliability.
- the compensation principle should be considered as the basic position for assessing the developer reliability: the negative impact of external factors shall be covered by the reserves of reliability of internal factors, which will ensure the reliability of the developer functioning as a whole.

3. Results
Depending on the strategic and tactical objectives facing the developers at various stages of his work, its reliability can be assessed according to any separately taken criterion featuring its activity. In particular, it is proposed to determine the developer reliability factor as follows:

\[ K_{rel} = \gamma_1 K_1 / K_1 + \gamma_2 (K_2 / K_2 + \sum \gamma_i K_i / K_i^{aver} (i = 3...9) + \gamma_{10} K_{10}^{aver} / K_{10}^{aver}) \]  

where
\[ K_{rel} \] – the general reliability factor of the developer;
\[ K_1 \] – financial stability index;
\[ K_2 \] – financial leverage factor;
\[ K_i \] (i = 3...9) – factors of advancing of construction in progress (i = 3), financial solvency (i = 4), liquidity (i = 5), turnover of receivables (i = 6), profitability (i = 7), economic growth (i = 8), equipment upgrades (i = 9);
\[ K_{10} \] – staff turnover rate;
\[ K_i^{aver} \] – industry average values of the above indicators;
\[ \gamma_1 \] – the significance of financial stability index;
\[ \gamma_2 \] – the significance of financial leverage factor;
\[ \gamma_i \] (i = 3...9) – the significance of factors advancing of construction in progress, financial solvency, liquidity, turnover of receivables, profitability, economic growth, equipment upgrades;
\[ \gamma_{10} \] – the significance of staff turnover rate.

Weight values \( \gamma_1, \gamma_2, \gamma_i \) (i = 3...9), \( \gamma_{10} \) should be calculated separately for investment-construction and developer organizations (in accordance with the list of used reliability factors) according to formula 2:

\[ \gamma = \rho_i / \sum \rho_i \]  

where \( \rho_i \) – an average expert score for the i-th factor.

If \( K_{rel} \approx 1 \), the developer has an average level of reliability, if \( K_{rel} < 0.3 \), the developer has low reliability, if \( K_{rel} > 1.2 \), the developer has high reliability.

In principle, developers with the average reliability can be considered organizations with \( K_{rel} > 0.9R \), where \( R \) is the maximum of the observed values of the reliability factor (when specifying industry average indicators, the R value shall be recalculated).
It is proposed to use similar indicators of competitors or the best in the industry as reference indicators, allowing determining the position of the developer in the market.

4. Discussion
According to many authors [17–18], the key issue is the legislator’s requirement to confirm the occurrence of an insured event using a court decrees, because, as already noted, in order to recover insurance compensation, it is necessary to fix the fact that the developer has violated the obligations under the partnership agreement. An insured event occurs when the developer fails to fulfill or improperly fulfill the obligations under the agreement. It is known that claims for reimbursement of losses to equity holders in connection with the non-transfer of the shared-equity construction projects or the non-return of attracted funds due to the non-building of the object shall be satisfied through the court. However, it is no secret that insurers take its time to pay compensation in case of an insured event, which means that the current wording of the article of Federal Law N218-FZ dd. 07.29.2017 on participation in shared-equity construction projects allows not only to delay the issuance of compensation by the equity holders, but also allows insurance companies to defer payment, using the money of beneficiaries. Thus, the introduction of a new law that specifies the creation of a compensation fund, contributes, on the one hand, to increasing housing costs (due to increased requirements for the financial situation of developers and the risk of lack of funding in the new fund), and, on the other hand, to increasing scopes of housing commissioning that leads to a decrease in demand. Implementation of the new requirements of federal legislation on shared-equity construction projects will allow for a sharp reduction in a number of problem objects in the market (Figure 1).

Figure 1. The scope of costs for completion of the problematic shared-equity construction projects, billion rubles.

In this case, there is a risk of decreasing the scope of new housing construction due to the exit of developers (including unreliable ones) from the market. Based on open sources, the authors formulated a forecast for distribution of housing construction of bankrupt developers in the Russian Federation by the scheduled dates for commissioning of facilities, which presents a negative trend in decreasing of the scope of new housing construction by bankrupt developers (Table. 1):

Table 1. Distribution of bankrupt developers housing construction in the Russian Federation by the scheduled dates of facilities commissioning.

| Years | Houses under construction, unit | Dwelling units, unit | Total area of dwelling units, sq. m. |
|-------|-------------------------------|----------------------|--------------------------------------|
| 2017  | 399                           | 36760                | 2028589                              |
| 2018  | 53                            | 15088                | 781583                               |
| 2019  | 16                            | 3791                 | 193645                               |
| 2020  | 7                             | 1950                 | 85329                                |
| 2021  | 3                             | 839                  | 70483                                |
In this negative scenario, the main role plays an unreasonably high rate of deductions to the state compensation fund from each partnership agreement (> 1%) concluded and registered in the Federal Service for State Registration, Cadastre and Cartography (Rosreestr) and the absence of the differentiated approach that would allow to correctly assess the reliability of developers (the legislator established a unified rate for all developers - 1.2%). However, in turn, the new law reduces the money loss risk. There is an alternative: either to select a housing construction cooperative and buy housing at a lower cost, but with more serious risks, including the risk of higher prices for housing during construction, or pay a large amount of money, but in this case, the risks will be less in the process of transaction implementation [19-20].

There is one more problem that we would like to mention. Energy modeling of buildings reduces sales risks in the sense that it contributes to expanding the spheres of business, hi-tech production, innovations and information telecommunication technologies, improve the state of the environment. In order to overcome the drawbacks of traditional construction, a number of “green” standards has been developed too on the basis of principles of sustainable development and providing for safe and favorable conditions for the people’ vital life sustenance, acceptable level of impact on the environment and taking into account a wide range of interests: — BREEAM (Building Research Establishment Environmental Assessment Method), developed by BRE Global company; — LEED (The Leadership in Energy & Environmental Design) offered by the U.S. Green Building Council (USGBC); — DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) presented for supporting the “green” building by the Council of sustainable construction of Germany. So, the mandatory requirements of LEED system are aimed at the construction of eco-friendly, economically- and energy-efficient buildings and entire districts convenient for living with the use of biopositive architectural and planning design concepts (see Table 2) [21].

| Line No. | LEED requirement                                                                 | Explanation                                                                 |
|---------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1       | Reduced pollution by construction activity                                       | It will be implemented at the early stages of construction. It is practically impossible to receive a certificate for certificates initially not planned for LEED |
| 2       | Reduced water consumption                                                        | The criterion sets rigid requirements regarding the use of energy-saving sanitary ware |
| 3       | Putting into operation the energy-saving systems in the building                 | It will be implemented at the early stages of designing. It is practically impossible to receive a certificate for certificates initially not planned for LEED |
| 4       | Minimum requirements to energy-efficiency                                        | The criterion contemplates compliance with the requirements of American standard of energy-efficiency of buildings (ASHRAE) comprising tight standards with respect to equipment in HVAC systems, heat conductivity of the enclosing structures, air tightness of building and systems |
| 5       | Air conditioning management and the use of freon-containing refrigerants          | The criterion produces requirements regarding the use of freon-containing refrigerants |
| 6       | Collection and storage of the secondary resources                                | The criterion dictates organization of separate collection of waste, providing a site for storage of recyclable materials |
| 7       | Quality of microclimate                                                          | The criterion standardizes the levels of air exchange in the building         |

DGNB takes into account the entire life cycle of the building and gives an assessment in accordance with more than 50 criteria grouped into six categories: environmental quality, economic efficiency, sociocultural qualities and functionality, technical equipment, process quality, location quality. The strategy of increasing capital expenses in order to minimize the operational expenses over a long period is well-disposed for the investors-developers planning to operate the real property. This approach assumes consideration of full life cycle of the building, evaluation of investments into green construction and payback thereof within an operational period. The “green” construction is associated with the synergetic effect, which proves itself, when ecological, economical, technological and other
effects complement and amplify each other creating a general effect exceeding the effects of every factor involved into economical process time and time again quantitatively and qualitatively [22].

5. Conclusions
Thus, we can draw some conclusions:

Implementation of the new requirements of federal legislation on shared-equity construction projects will allow for a sharp reduction in a number of problem objects in the market. Moreover, the “problem zone” of shared-equity construction has been identified, which consists in the absence of a correct methodology for assessing the reliability of developers and a differentiated “grid” of interest values from the concluded partnership agreements.

The mandatory deductions of 1.2% of the amount of DDU specified by the legislator increases the already very significant financial burden on developers. 1.0% is quite enough to fully provide for payments to defrauded “homebuyers” or to complete the construction of problematic facilities. Moreover, in the next 5 years, an annual increase in this rate will also not be required (this possibility is defined in Federal Law N 218-FZ dd. 07.29.2017).

To ensure the developer reliability, the supervisory authority shall perform a correct and comprehensive assessment of its financial and economic activities. Moreover, the deduction rate shall be differentiated depending on the experience of the developer activities for creation of similar facilities, its portfolio, an amount of equity, financial and economic indicators of its activities for a certain period, etc. In addition, the system of standards for energy modeling allows the use of data for optimal pricing in order to avoid risks and harmonize relations between developers and shareholders at an early stage of the project. The biopositive construction projects (including energy modeling of buildings) reduces sales risks generating conditions for equilibrium and steady relationship between eco-system and economics of construction under conditions of changing environment and internal transformations.

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