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EFFICIENCY OF PROJECT IMPLEMENTATION FOR THE RESTORATION OF UKRAINIAN OBJECTS

Druzhinin Eu., Davydenko O., Obukhova N.

Under the conditions of a market economy, a crucial indicator of the implementation of projects to restore damaged objects in Ukraine is the assessment of the economic efficiency of investments, which is a comparison of the profitability of investment options. In a market economy, investment efficiency will depend on the investment in restoration and the market value of the restored facility. The problem of assessing the efficiency of investments depends on the formation of an investment strategy for choosing the most efficient use of the restored facility. The risks of an investment project should be taken into account when determining the effectiveness of investments in facility restoration. Implementation of the BIM technology system will reduce risks and ensure the efficiency of a construction project at different design stages.

Introduction

The post-war recovery of Ukraine is primarily about rebuilding the country and intensive economic growth. The question arises as to how to quickly and cost-effectively restore the destroyed economic objects, as their number is growing.

The main areas of restoration of damaged objects should be the restoration of the facility in its original form, reconstruction and diversification.

A facility restoration project goes through all stages of the life cycle, and each of them is an important part of the systemic work on its implementation. When implementing projects to restore damaged objects, special attention should be paid to the pre-project and project stages. The pre-project stage involves conducting a technical inspection of structures and determining their further suitability; determining the amount of damage caused to the objects as a result of destruction and damage; assessing technical options for restoring the facility; assessing the economic efficiency of investments in the restoration project with an estimate of the market value of the restored facility. The implementation of the design stage involves the development of project documentation using BIM technology, and determining the cost of restoring the damaged facility in market conditions, as well as project approval. The features of the selected stages are disclosed in this paper.

Economic efficiency of investments in the restoration of damaged objects

Under the conditions of a market economy, the decisive indicator is the assessment of the economic efficiency of investments in reconstruction, which

is reduced to a comparison of options for the profitability of investment based on the determination of the expected net income by various methods.

The assessment of the economic efficiency of investments is reduced to comparing the profitability of a particular placement of funds (capital) based on the determination of net income by various methods. The assessment of the economic efficiency of real investments – capital investments is based on a number of fundamental principles:

1. Estimation of the return on capital based on the cash flow (W_k) generated by profit (P) after tax and depreciation (M), which are received during the operation of the object and remain at the disposal of the investor:

$$W_k = P + M. \quad (1)$$

2. Mandatory adjustment to the current value of both the invested capital (K) and the amount of cash flow (W).

This is due to the fact that cash, instead of being invested, being invested in a bank guarantees an income at the level of the interest rate. In addition, future cash flows must be discounted to the present due to the loss of the value of money.

3. Selecting a differential interest rate (discount rate) in the process of discounting the cash flow for different options for investing in the restoration of the facility.

4. Variation in the forms of using the interest rate for discounting depends on the purpose of the valuation and can be assumed to be equal to

– average deposit or lending rate;

– an individual rate of return adjusted for inflation;

– an alternative rate of return;

– the rate of return on current business activities.

These circumstances require that when assessing the economic efficiency of investments in each specific case, the interest rate norms and multivariate calculation should be justified, taking into account the forecast of its change in the future.

The implementation of the principles of assessing the economic efficiency of capital investments has led to the emergence of various assessment methods that are recommended to be applied comprehensively: the method of net present value, profitability index, payback period, internal rate of return.

The net present value method (W/NPV) involves calculating the difference between the present value of cash flows for the life cycle period – operation of the facility (W_k) and the amount of investment – capital investment (K) in the restoration, reconstruction, diversification, brought to the current moment:

$$W = -K + W_k \quad (2)$$

The investment life cycle is the period of time from the start of investing in a real investment project to the next significant investment in an existing facility.

There are 2 stages of the investment life cycle:

1) the investment period – before the start of operation of the facility;

2) the period of operation of the facility – until the start of subsequent investments in technical re-equipment. The invested capital (K) is calculated for the 1st period, and for the 2nd period, if the duration of the 2nd period is uncertain, most researchers recommend taking it equal to five years, which corresponds to the average depreciation period of equipment, after which it is subject to replacement (in countries with established market economies).

When comparing comparable investment options, the option with the highest positive W/NPV is preferred.

The rate of return method largely coincides with the previous method, but involves determining the average index of return on options (E') as the ratio of the present value of cash flow (W_k) to the present value of investment (K):

$$E' = \frac{W_k}{K}. \tag{3}$$

The payback period method involves the calculation of the turnover period for which the present value of the investment (K) at the average amount of cash flows brought to the current moment $(\overline{W_k})$, for long-term investments, will return to the investor:

$$T_{ok} = \frac{K}{\overline{W_k}}. \tag{4}$$

The internal rate of return method involves calculating the internal interest rate that ensures the return of the invested amount (K), i.e. $W = 0$.

The analysis of four methods for assessing the economic efficiency of capital investments shows that the net present value method (W) meets the objectives of studying the efficiency of investments in the reconstruction of damaged facilities [1, 2].

Assessment of the economic efficiency of one-time investments in a one-time purchase of fixed assets involves determining the maximum positive value of the net present value of income $\left(W^{ok}\right)$ for the period n:

$$W^{ok} = \sum_{t=1}^{n} \frac{W_{kt}}{(1+I)^t} - K'. \tag{5}$$

When rebuilding, reconstructing or diversifying facilities, there are multiple investments that are made over several months or years (τ) in instalments with a net present value return in subsequent years (n). In this case, the investor incurs losses associated with freezing funds K^{pk} for τ years at a certain interest rate (I):

$$K^{pk} = \sum_{j=1}^{\tau} K_j (1+I)^{\tau - j}. \quad (6)$$

The maximum present value of net income (W'') for a period of n years of multiple investments under the options is:

$$W'' = \sum_{t=1}^{n} \frac{W_{kt}}{(1+I)^t} - K^{pk}. \quad (7)$$

These provisions are adopted as the basis for modelling the market value of destroyed objects in the course of their multivariate reconstruction to assess the economic effect of the buyer's investment.

In a market economy, the regulator of capital market development is the interest rate (I), which causes the loss of equivalence between investments and current costs over time (t).

To estimate the real term of return on investment – the payback period – it is necessary to take into account this temporal unevenness of cash flows, bringing their value to the initial year.

In the case of a one-time investment within a year $\left(K^{ok}\right)$:

$$K^{ok} = \sum_{t=0}^{T_{ok}} \frac{W_{k_t}}{(1+I)^t}, \quad (8)$$

where W_{k_t} net income in the t-th year after investment, UAH;

I – interest rate, in fractions of a unit;

T_{ok} – payback period, years.

In this case, we are talking about current costs, which implies a uniform income flow within each year and allows us to use the expression:

$$K^{ok} = \sum_{t=0}^{T_{ok}} W_{kt} \cdot e^{-I_t}. \quad (9)$$

After converting using the geometric progression and logarithmic formula, we find the payback period:

$$T_{ok} = \frac{1}{I \cdot \left(\ln W_k - \ln\left(W_k \cdot e^l - l \cdot K^{ok}\right)\right)} + 1. \quad (10)$$

For the purposes of analysis, it is advisable to express the net income of each year after investment in terms of the rate of return (E) on investment:

$$W_{k_t} = K^{ok} \cdot E_t \cdot \tag{11}$$

Then the output formula will take the form:

$$E_t = \frac{l \cdot e^{l \cdot (T_{ok-1}))}}{e^{l \cdot n} - 1}. \tag{12}$$

If we assume $I = 0 - 0{,}5$ with an interval of 0,05, $T_{ok} = 0 - 10$ with an interval of 1, we can build a nomogram to justify the rate of return on the average over the payback period, taking into account the fall in the equivalence of cash at a certain interest rate (I).

In a market environment, the effectiveness of the investment will depend on the investment in the rehabilitation and the market value of the rehabilitated property.

Market value is the most likely price that a property would fetch in a competitive and open market, provided that all conditions of a fair sale are met.

To determine the market value of real estate, three methodological approaches are used: cost, comparative, and income.

An analysis of the methodological approaches to determining the market value of real estate showed that they are focused on the valuation of completed construction projects, while destroyed properties require additional investment and time to rebuild, reconstruct or diversify. The leading method for assessing economic efficiency is the method of calculating the net cash flow over the life cycle of an investment based on the equality of the cash flows of the seller and the buyer.

The problem of assessing the efficiency of investments depends on the formation of an investment strategy for choosing the most efficient use of the restored object.

The initial stage of developing an investment strategy is to determine the overall period of its formation, which depends on the predictability of the development of the economy as a whole and the investment market. The effectiveness of the investment strategy depends on the reliability of the forecast and the justification of trends in the factors that shape the investment climate, which affects the state of the investment market in the future. Forecasting the investment market conditions is a probabilistic process of strategy formation [3].

All forecasting methods are grouped into three groups: expert estimates, logical modelling, and mathematical. The analysis of methods shows that in order to solve long-term problems of forecasting the investment market and the real estate market, which is part of it, requires the integrated use of various forecasting methods

and justification of forecast calculations depending on the information support of decision-making conditions for the restoration of facilities, based on the factor approach.

When determining the effectiveness of investments in facility restoration, the risks of an investment project should be taken into account – a set of possible circumstances that may cause a decrease in project efficiency or the impossibility of its implementation [4, 13].

Particular attention should be paid to the following risks:

– pre-project phase risks (errors in the technical inspection of structures and determination of their further suitability; determination of the amount of damage, assessment of technical options for the restoration of the facility)

– risks of the project phase (errors in design and budgeting, incorrect calculations of probability and expected financial receipts, imperfect forecasting and determination of project implementation time).

The introduction of BIM technologies will allow:

– during the technical inspection of facilities – to reduce the time of the inspection, build a 3D model of the damaged object and compare it with the original appearance of the building, determine the level of structural damage;

– during design – to significantly increase the objectivity and reliability of design decisions, reduce the likelihood of design errors, reduce the cost of project development and reduce the time for developing project documentation.

– at the project implementation stage – to increase the efficiency of resource use, minimise the availability of warehouse stocks directly at the construction site, promptly adjust construction costs, and reduce construction time;

– support at the stage of facility operation – determination of operating costs, efficiency of work on the restoration, reconstruction and diversification of facilities.

Problems of designing construction projects using BIM technology in Ukraine

The implementation of a BIM technology system should ensure the efficiency of a construction project at various stages of design, implementation and operation.

The use of BIM technology in the design and construction process allows you to quickly access any information about the facility, control the quality of work at all stages, avoid conflicts in the project, and significantly reduce construction costs. However, the main advantage of implementing BIM technology in construction is the ability to achieve almost complete compliance of the characteristics of the future facility with the customer’s requirements [6].

The introduction of BIM technologies in Ukraine has many challenges that need to be addressed through software improvements.

Today, the formation of a 3D design model is associated with software tools: the architectural part of the project (Autodesk (Revit), AllPlan Deutschland GmbH, Graphisoft (Archi CAD), Tekla Corporation, AutoCAD, and others); the structural part (LIRA – CAD, Monomakh, SAPFIR); plumbing and electrical parts (Magi CAD for AutoCAD). These software systems are autonomous products that are not connected to each other and have different owners, which makes it difficult for independent developers to implement them. A number of measures are proposed to export data and establish feedback between these programmes.

A significant number of software products operating in Ukraine remain disconnected from the 3D project model, including 4D construction organisation and management (Microsoft Project, Primavera P6, Spider Project, etc.); 5D estimate and contract pricing (Construction Technologies – Estimate 8.1 (Computer Logic Group), ABK−15, AC−4, TK Investor)[12].

In designing the organisation of construction production, it is important to choose a method of construction organisation and models to substantiate the technical and economic indicators of the relevant organisational projects, among which the following models should be distinguished: analytical (calculations of initial data, tables, matrices), graphical (tape chronograms, network, cyclograms), computer (programs such asProject, Allplan).

Software products such as Microsoft Project provide satisfactory construction schedules for an object under certain deterministic or probabilistic indicators of the duration of work, the combination of work and time, and the cost of investment by construction period. However, the reliability of the resulting models depends on the state of the regulatory and reference base and the dynamics of its change over time. This is how the transparency of the regulatory framework for labour and machine resources in determining the duration of work has been lost [7, 8].

The BIM 6D system allows for the calculation of energy efficiency and energy consumption of a building, as well as comprehensive calculations of the economic efficiency of the entire building (taking into account the location) and all its elements simultaneously. When using BIM 6D and 7D, 8D, it is possible to additionally collect and use various information about the object in one central system, which allows for efficient use of the building and its operating time. Due to this, the functional BIM 6D, 7D, 8D system is used in facility management, but there are no software products of this level in Ukraine [9, 10].

The use of BIM technology increases the objectivity and reliability of design decisions, the likelihood of obtaining real indicators in the restoration of affected facilities and the construction of new facilities. The development of software in accordance with BIM technology will allow for the design, organisation and management of construction projects at a modern level.

Conclusions

The above provisions indicate that the basis for assessing the economic efficiency of the restoration of damaged objects should be a model of discounted equilibrium net income for the investment cycle with forecasting the market value of the restored object and additional investments at a certain rate of return.

The introduction of BIM technology in the process of restoring damaged facilities has undeniable advantages, as it allows instant access to any information about the facility, control over the quality of work at all stages, and avoidance of project conflicts. The development of new software products and improvement of existing BIM-based programmes is relevant for Ukraine.

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