To Issue of Mathematical Management Methods Applied for Investment-Building Complex under Conditions of Economic Crisis

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Abstract. In the article the authors consider a cognitive management method of the investment-building complex in the crisis conditions. The factors influencing the choice of an investment strategy are studied, the basic lines of the activity in the field of crisis-management from a position of mathematical modelling are defined. The general approach to decision-making on investment in real assets on the basis of the discrete systems based on the optimum control theory is offered. With the use of a discrete maximum principle the task in view of the decision is found. The numerical algorithm to define the optimum control is formulated by investments. Analytical decisions for the case of constant profitability of the basic means are obtained.

1. Introduction
Crisis development of a situation in the organisation of building branch is a result of negative influence of various external and internal factors of development in market conditions. In the modern world crisis became the constant companion of business, and this phenomenon is defined not only the objective reasons outwardly - and internal political and economic character, but also the certain mentality which has developed in the conditions of permanent expectation of crisis and instability of key directions of functioning of branch and economy as a whole [1,2].

Management of a modern building complex assumes management of the investments stimulating both development of branch, and all economic sector. The scientific substantiation of a choice of investment model of development demands the developed mathematical apparatus, allowing to count probable variants of succession of events, systematically and in due time to react on situation changes, to soften negative consequences. The present work is devoted a choice and a substantiation of optimum mathematical model on the basis of the author's analysis and calculations.

2. The historical background
The problem of efficient evaluation of the investment cycle and effective investment management using mathematical modeling and forecasting processes have been studied in many different scientists. It is referred to R. Braley, S. Myers [3], Ju. Brighem [4], B. A. Lagos [5], who studied problems of economic analysis of investment projects, including mathematical methods of analysis.
The monograph by Y. V. Kosachev “Economic-mathematical model of efficiency of financial-industrial structures” [6] gives one of the most complete descriptions of the mathematical models, analyzing financial component of the economy of production and possibility of its management.

The most important information on this issue reflects the article the “Mathematical model of optimal control of investments in real assets” by O. V. Pavlov, T. A. Moshkova [7] The article O.A. Pobegaylov and O. V. Klyuchnikova "Rationalization of strategic management principles as a tool to improve construction services company" [8] says about the creation of the optimum mechanism of management of strategic investment of the company and the need to create a comprehensive mathematically correct machine management. The difficulties associated with objective analysis tells of the monograph David Hussey "Strategic management. From theory to implementation" [9]. Consolidation of the ideas of leading scientists in the field of production management is one of the objectives of this study.

3. Algorithms of diagnosing and mathematical modelling of an estimation of quality

The mentality of the modern businessman assumes constant control of crisis situations and existence in the conditions of crisis that leads to occurrence of psychological effect of crisis dependence when any activity is reduced to is short periodic functioning in the market, in the conditions of race behind profit. Any business, any project appears is unpromising in the long-term relation as in the conditions of crisis its survival rate promptly falls, and it quickly enters into an unprofitable phase. It is obvious that in this condition any investment appears probable only in such projects which guarantee high speed of realisation at a minimum of predicted expenses. It is natural that the question of a high-grade parity of the price, quality and modernization potential of the objects realised thus simply is not necessary [3,10]. It is possible to result one example brightly illustrating a situation: The increasing and great popularity the time habitation - fast trade types buildings with operational suitability no more than ten years, the minimum initial comfort, from materials of secondary processing, wood, ceramoplastics etc. Thus the object is entered in any existing site of building, without any intelligent general layout of building of area, without an adequate estimation of its long operational suitability. In the scientific environment appeals to speeding up of methods of building, by a way reduction of a spadework, examinations, creations unbase designs or working out of technologies of repeated operation of the existing bases [11,12] are in increasing frequency distributed.

At all visible progressiveness of similar innovative workings out, in a reality the creation project investment - the attractive object possessing high economic efficiency in crisis is realised. That, actually, "disposable" it is not accepted to speak similar object [13, pp. 81-90].

In these conditions the investor is obliged to choose the optimum scheme of financing of the manufacture, counted by objective mathematical methods.

Therefore we consider a problem of optimum control of investments by means of realistic mathematical models - management of actives in discrete statement. As criterion of management of investments we use criterion of the pure discrete income

Authors apply to a choice of investment decisions the optimum control theory discrete processes [14]. As criterion the sum of the discounted profit of the building enterprise for a planning interval was used. However for practical economic calculations the problem decision in a discrete kind is more preferable. Thus, the mathematical model of monetary streams of the investment project of the building enterprise which is the unique participant of the investment project on manufacture of a new kind of production, is developed taking into account the optimal investmentno-administrative decisions applied in branch. For cleanliness of experiment and taking into account circumstances about which it was told earlier, economic efficiency of the project is estimated as a whole and the financing scheme is not considered [15,16]. Monetary streams of operational (industrial) and investment activity [17] are considered. As a result of project realisation all made production completely is on sale. It is considered that the monetary stream generated by the investment project in a current of one time period takes place in the end периода quality of criterion of an estimation of
economic efficiency of the investment project the pure resulted income defined under the formula is considered:

$$NPV = \sum_{t=0}^{n} \frac{FCF_t}{(1+r)^t}$$  \hspace{1cm} (1)$$

The planning horizon is defined as the objective factor: life cycle of the investment project, and subjective: foresight of the manager, making the decision. [7]. The free monetary stream of investment project $FCF_t$ in the end of the period $t$ is defined as a difference of monetary streams from operational ($OCF_t$) activity and investment ($JCF_t$):

$$FCF_t = OCF_t - ICF_t, t = 0, n$$  \hspace{1cm} (2)$$

For calculation of deterioration of the basic means (non-current assets) of the enterprise the method of uniform charge of amortisation is used:

$$DEP_t = \mu FA_t$$  \hspace{1cm} (3)$$

where $\mu$ - norm of amortisation, $FA_t$ - cost of the basic means of the enterprise in the period beginning $t$ before new capital investments.

All basic means of the project are completely used for production. In this case process of industrial activity of the enterprise is described by production function of Leonteva:

$$P_tQ_t = fFA_t$$  \hspace{1cm} (4)$$

where, $P_tQ_t$ is the value of projected sales (revenue) $f$ capital productivity of fixed assets, characterizing the technological process used for production [7].

The economic sense of the profitability of fixed assets is the amount of operating cash flow per unit value of fixed assets used in the project. The profitability of fixed assets depends on the price and cost of production, return on assets, rate of profit tax and tax shield associated with the depreciation. The profitability of fixed assets cash flow according to its economic meaning close to the concept of return on investment on the cash flows.

Naturally, investments must be made one period earlier than the planned growth in productive capacity necessary to meet future projected sales of finished products, i.e. implementation of construction projects [4,18].

Thus, for investment in the initial period of time the profitability of fixed assets should not be less than the refund rate capital. It is obvious that with the increase of the planning horizon $n$, the critical value of the return decreases, therefore, the longer the planning horizon, the smaller can be critical to profitability of fixed assets in the initial period.

From the equality to zero of the terms

$$\frac{ROFA}{r} \left[ 1 - \frac{r}{ROFA} \right]$$  \hspace{1cm} (5)$$

it is easy to determine the period of termination of the investment:

$$t^0 = n + \log_{1+r} \left[ 1 - \frac{r}{ROFA} \right]$$  \hspace{1cm} (6)$$

From economic sense, it follows that the expression in parentheses is less than 1, so the logarithm of a negative number and time of the termination of the investment is in the range from 0 to $n$. by analyzing the formula, we can conclude the following: the time of the termination of the investment depends on the planning horizon: the greater the period of time it is expected to implement an investment project, the longer you need to invest in fixed capital.
4. Conclusions
Thus, we propose to use a common approach to investment decisions in the construction based on the theory of optimal control of discrete processes.

Practical calculations have shown the effectiveness of the proposed algorithm for making investment decisions that will help to avoid unnecessary decisions related to the selection of suboptimal investments. This condition can be used as a criterion for making a decision about investing in the project under consideration. From the conditions obtained analytical formula for determining the termination period of the investment [19,20]. In the management of the investment complex in the conditions of crisis the functioning of the regional investment-construction complexes are characterized by large cycles, respectively, and the risks of losses are large enough that allows the investor to require contractors transparency in the presented projects, as well as in the history of the activity in this area. Thus, at the tender, the investor may have to focus not only on the image indicators of the proposed projects, but also on their hidden, essential characteristics, which in turn allows us to manage the investment and only profit in the long run.

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