

## **MODERN ASPECTS OF INVESTMENT AND APPROACHES TO ITS ASSESSMENT**

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*The authors explore modern aspects of investments in the economy. Substantiate the possibilities of using artificial intelligence based on neural networks (NM) to make investment decisions in domestic enterprises. As a result of the research, the priority areas of investment are identified and recommendations on approaches to the evaluation of investment decisions using a neural network are provided.*

### **Introduction**

The complexity and versatility of the problems associated with the financing of modern projects require the development of appropriate evaluation methods, basic criteria and appropriate economic tools for investment decisions. The implementation of artificial intelligence in the information system of the enterprise will improve the process of evaluation and selection of investment projects. However, the use of the latest information technologies should be considered as an important area of investment, which also requires appropriate performance appraisal. The intensification of the complexity and instability of economic processes necessitates the improvement of the company's information system so that it provides an assessment of all possible alternatives and selects the most effective investment decisions, taking into account possible risks.

*The aim of the study is to study the role of investment in the modern economy and approaches to the evaluation of investment decisions based on neural networks to obtain competitive advantages and increase the efficiency of the enterprise.*

The relevance of the study is due to the need for an integrated assessment of investment decisions in order to justify the implementation of the most effective project to achieve this goal, as well as reduce risks in its implementation.

Researchers such as J. Keynes, S. Fisher, K. McConnell, J. B. Thompson, D.A. Harrison, V. Komarov, M. Kagalovsky, I. Blank, S. Lazarev, A. Kostrov, A. Filipenko, V. Ponomarenko and others studied the theory of investment and its role in economic development.

The investment decision-making process is closely linked to the definition of quantitative and qualitative relationships between performance indicators and requires the use of certain modeling methods. Information-intellectual technologies (IIT) are the last stage of development of analytical technologies which on the basis of models, algorithms, mathematical theorems allow to estimate values of unknown characteristics and parameters according to known data. Thus, information-intelligent technologies can be defined as a formed, constantly modifying complex of technical, methodical, informational and software, which on the basis of tools and methods of information processing implements monitoring, analysis, forecasting, identification, motivation, stimulation and decision-making [1]. Neural networks are one of the classes of intellectual information processing for complex evaluation of investment decisions.

The founders of artificial neural networks are W. McCulloch and W. Pitts [2], who proved that with the help of threshold neural elements it is possible to implement the calculation of any logical functions. D. Hebb [3] developed a mathematical basis for learning a number of neural networks. F. Rosenblatt [4] proposed and investigated a model of a neural network, which he called a perceptron. In 1969, M. Minsky and S. Pipert [5] published a monograph "Perceptrons", which gave a mathematical analysis of the perceptron, and shows the limitations inherent in it. T. Kohonen [6] developed and investigated how self-organizing neural networks. A number of authors D. Rummel-Hart, D. Hinton and R. Williams have proposed an algorithm for reverse propagation of error, it is of the greatest interest because it is an effective tool for training multilayer neural networks of direct propagation [7].

NN are rapidly gaining more and more areas for their application, especially in the economic sphere. This is facilitated by their flexibility, ability to learn, which

provides developers with a large number of opportunities to predict and model different alternative scenarios in a changing economic environment.

The main purpose of neural networks is that based on the analysis of large amounts of information that reflects individual cases, the general patterns for recognizing new cases are determined. Neural networks are Bayesian classifiers that operate in the absence of knowledge of the probability distribution function. Knowledge, recorded as the weight of several hundred interneuron connections, is not at all amenable to analysis and interpretation by man. The most famous software products for the implementation of neural network systems are Brain Maker by California Scientific Software, Neural Works Professional by Neural Ware, AN Sim by SAIC [1]. After all, the analysis of scientific works allows us to conclude that there is a wide range of possible applications of neural networks from evaluating the effectiveness of investment to personnel decisions.

The application of information-analytical systems for decision-making was studied by both foreign and domestic scientists: S. Bratushko, M. Demidenko, V. Sytnyk, S. Subbotin, L.V. Shchhavelev and others [8]. Problems of building the information system of the enterprise are covered in the works of O. Frolenko, J. Panukhnyk, O. Sokhatska, but the improvement with the use of neural networks has not been sufficiently considered.

The authors of this study addressed the issue of improving the MIS of the enterprise on the basis of NN (see, for example, [9]), but did not take into account aspects of forecasting macroeconomic indicators of the enterprise, which can influence the development and implementation of investment projects. In [10], the authors conducted a study of a mathematical model for forecasting macroeconomic indicators of Ukraine's economy, but did not use NN to predict the processes of the internal environment, such as, for example, forecasting the cost of engineering services.

Thus, the need to develop a methodology for evaluating investment decisions by means of NN is obvious. In practice, such a methodology will provide an

opportunity to justify the feasibility of investment decisions, reduce the risks of implementation and implementation of investment projects, taking into account the impact of the market environment.

### **Research methodology**

There are different approaches to the interpretation of the concept of "investment", but according to the authors the most successful is given in [11], namely: investment is defined as the cost of formation, replacement (full and partial) and/or increase in available capital. The classification is given in table 1.

According to the international method of economic analysis, the main classification feature of investments is the object of investment. Real investment objects are:

Table 1

**Classification of investments [11, p.346]**

<b>Classification criterion</b>	<b>Forms of investment</b>
<i>By object of investment</i>	- real (tangible and intangible assets); - financial (securities (stocks, bonds, treasury bonds), cash deposits)
<i>By its role in reproductive processes</i>	- renovation investments (source: depreciation); - net investment (source: savings)
<i>By appointment</i>	- reconstruction; - new construction
<i>On time</i>	- short-term (payback period up to 1 year); - medium-term (up to 3 years); - long-term (over 3 years)
<i>By subjects of investment</i>	- private; - state; - mixed; - foreign

1) tangible assets: fixed assets (machinery, equipment, buildings and structures for industrial purposes), housing, inventories (goods deposited by firms as an insurance stock of raw materials, work in progress and final products);

2) intangible assets: intellectual property (patents, licenses, know-how, software), land use rights and other resources, property rights, staff training costs, etc. [11, p. 347].

It should be noted that at the present stage of economic development the role and importance of human capital as one of the areas of real investment is growing. There is a need to quantify human capital in investment decisions, due to factors such as the leading role of man in social production; the importance of human resources compared to material resources; recognition of man as the main source of ideas, knowledge, their accumulation, renewal and the possibility of implementation. Given these factors, human capital is one of the main objects for investment.

It should be borne in mind that in different sections of science and different fields of practice, the content of the concept of investment has its own characteristics, namely:

– *in macroeconomics, investment* is part of the total costs, consisting of the cost of new means of production, investment in housing, and the growth of inventories. That is, investment is the part of GDP that is not consumed in the current period, and provides capital growth in the economy;

– *in the theory of production, and in microeconomics in general, investment* is the process of creating new capital (means of production, human capital);

– *in financial theory, investment* is understood as the acquisition of real or financial assets, i.e., it is today's costs, the purpose of which is to obtain future profits [12, p. 8].

The size and dynamics of fixed capital investment are influenced mainly by income factors. The logic of making investment decisions at the micro level is based on the following considerations.

First, the goal of any business is to maximize profits. The investment project will bring additional income only if the return on it exceeds the cost of its preparation and implementation [11, p. 350]. The most universal from the standpoint of the sphere of use in the investment process is the monetary form of capital. Therefore, it is important to identify sources of capital financing. Investment activity can be carried out both at the investor's own expense and borrowed. The most common external source is a bank loan. The price of borrowed money is bank interest. In other words, the lower is the interest rate, the higher is the expected profit, and, as a consequence, the investment activity of the entrepreneur increases.

The bank interest rate is formed in the conditions of market relations. The various investment resources, goods and instruments used by the enterprise in the process of investment as an object of purchase and sale form a special type of market - investment, the elements of which are supply, demand and price, and in which certain subjects of market relations operate. The investment market is formed by the whole system of market economic conditions, closely related to other markets (labor market, consumer goods and services market, etc.) and operates under the influence of various forms of government regulation [12, p. 9].

Second, investments involve a preliminary consideration of various alternative investment opportunities in any business and the choice of the most profitable of them. That is, it is important to solve the problem of evaluating investment alternatives, their selection and selection of the most effective.

The theoretical and methodological basis of the study under consideration are scientific methods of economic theory in the field of investment using an abstract-logical approach in the study of economic processes and phenomena, in particular such as:

– *scientific generalization* that is a set of successive actions to summarize specific individual facts into a single whole in order to identify typical features and patterns inherent in the phenomenon under study in determining the nature and classification of investment projects,

– *the dialectical method*, which requires consideration of economic phenomena and processes in their continuous movement, relationships and interaction in determining the place and role of investment activities among other activities of the enterprise,

– *the genetic approach* involves the study of the origin and formation of an economic phenomenon or process, as well as its derivation of each subsequent state from the previous in the study of world experience and determining stages of development of methods of analysis of investment projects based on the dialectic of unity and integrity,

– *the metaphysical method* requires a focus on the static state of the object of economic research, outside of its connections with other objects, on its functioning, and not on its development. These requirements are more appropriate to the functional approach, according to which the economic object under study is assigned the status of a function, and the influence of objects on it – the variable arguments. The use of mathematical tools makes it possible to establish a functional relationship between them, in particular, the degree of function changes depending on changes in arguments [13, p. 115] when establishing mathematical dependencies of the influence of factors in the evaluation of an investment project;

– *scientific abstraction*, that is, the formation of images and models of economic reality through the use of cognitive procedures of distraction and replenishment in the development of economic and mathematical models for analyzing investment projects in enterprises and calculating investment performance indicators,

– *theoretical provisions of system analysis in the decomposition of the functioning of the business entity into different subsystems and groups of indicators; when developing methods of analysis of investment projects in enterprises,*

– *economic-mathematical modeling* involves the construction of various dynamic models of the object, which allow to draw appropriate conclusions about the probable future characteristics of the object [13, p. 127] when building an

explanatory model that allows you to simulate market situations within alternative scenarios. The causal structure is established, one or more scenarios are developed and for each selected scenario the efficiency of investments is estimated. The causal structure is established and tested experimentally, under conditions that are subject to objective observation and measurement;

– *methods of fuzzy modeling* in the construction of neural networks for the assessment of various alternative investment opportunities in any objects of economic activity and selection of investment decisions;

– *methods of economic analysis* in substantiating the choice of evaluation subsystems;

– *methods of statistical analysis in the processing of quantitative indicators*;

– *expert intuitive method involves the use of expert information in the absence of data on the development of the object in the past or the absence of historical analogues in assessing and ranking the input parameters of a comprehensive evaluation system of the investment project.*

In summary, it should be emphasized that the results of applied economic modeling is not a ready-made project of the desired solution, but a certain way of organizing, organizing a huge amount of information that helps in decision-making [13, p. 150].

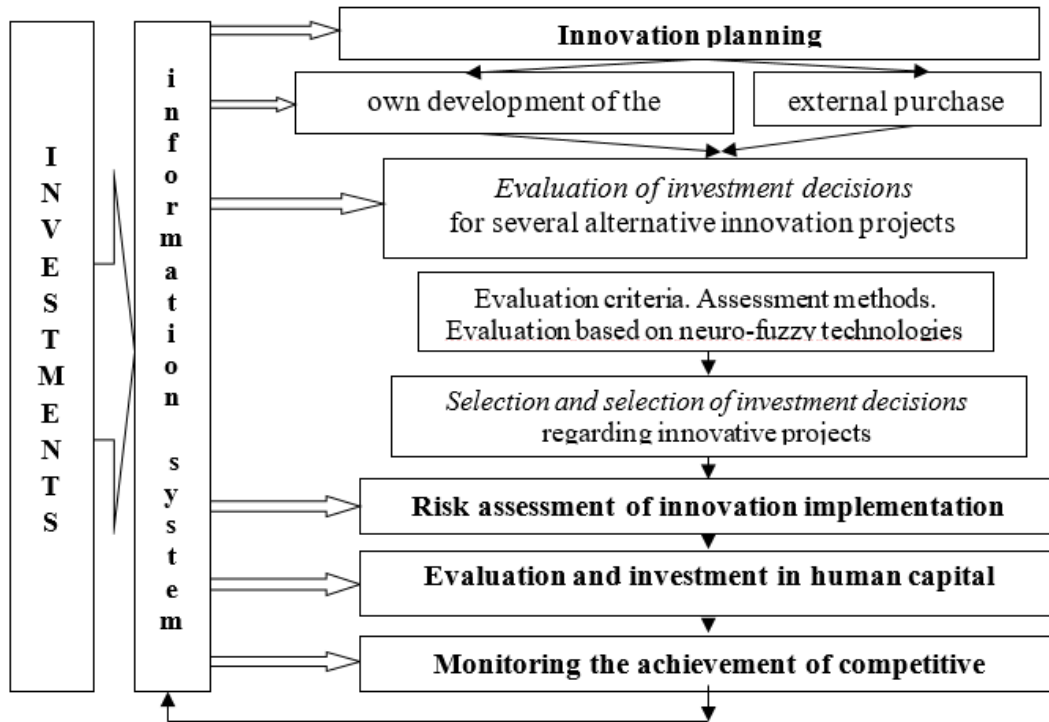
### **Research results**

Innovation and investment activity, as part of the overall strategy of enterprise development, must change, i.e. be transformed in accordance with the economic situation.

As you know, the process of innovation management consists primarily of planning innovative projects in the enterprise. This means that at this stage it is necessary to determine what innovations are needed, to make decisions on self-development by the R&D department, or, more appropriate, to invest in relevant innovations. The information system must have an appropriate innovation marketing



subsystem, in order to study the best practices of leading companies based on the benchmarking approach. The manager receives comprehensive information and decides which innovations should be purchased and which will be developed at the enterprise. The second stage is the evaluation of investments, i.e. decision-making on investments for each innovation project under consideration (fig. 1).



**Fig. 1.** The scheme of evaluation of investment decisions in the process of innovation management

The approach to the evaluation of investment decisions in the process of innovation management, which is presented in fig. 1, has a number of features that should be noted.

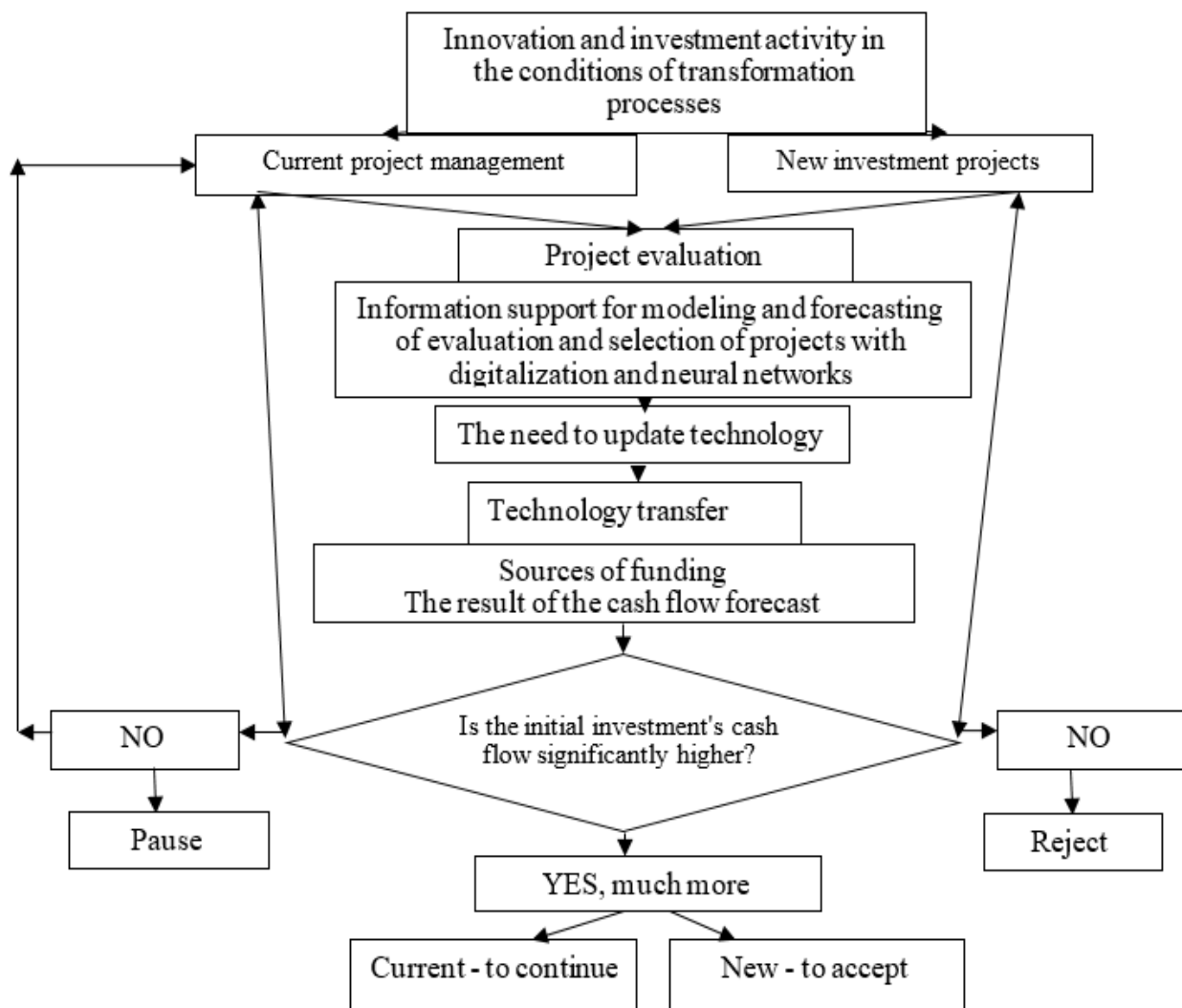
Therefore, in order to evaluate investment decisions based on neural networks, it is necessary, first, to start with the restructuring of the enterprise information system and the creation of appropriate infrastructure. Second, to provide access to the study of the innovation market, i.e. the assessment of all possible alternatives for procurement based on technology transfer, as well as the ability to assess the

integration of their own developments with the purchased ready-made solutions. Third, it is the evaluation of investment decisions using artificial intelligence based on neural network technologies. Its presence allows to accelerate the selection and selection of innovations, which in turn ensures their dissemination and rapid implementation in key areas of the enterprise. Fourth, the analysis of property rights and intellectual property. It is important that the legal mechanism allows for their implementation and that it is possible to ensure the protection of intellectual property. It is obvious that the rapid spread of new technologies and entry into the markets of high-tech products are impossible without the development of standards. This is the only way to ensure the rapid introduction of technologies and innovations in production, rapid commercialization of the results of intellectual activity and obtaining specific economic effects [14]. Fifth, minimizing the risks of innovation. Sixth, it is an assessment of investment in human capital, which takes into account its efficiency and the price paid by the company for attracting individual human capital. The application of an economic approach to the assessment of human capital creates the conditions for a transparent and informative basis for accounting and analysis. This in turn creates the conditions for the development of investment programs for the development of individual human capital of each individual employee.

Feedback is also important to assess the achievement of competitive advantage as a result of investing in a relevant innovation project. As can be seen from fig. 2, in the current conditions it is no longer enough that the efficiency indicators were higher than the initial investment, they should be much higher, at least three to four times higher, and only in such conditions it is possible to continue current and make new investment decisions or innovative projects.

Among the most common simulation computer systems that can be used to assess the effectiveness of investment projects are: Comfar (UNIDO) - the first investment analysis program that appeared on the domestic market of software

products and became a benchmark for the development of other software packages, Project Expert Professional (firm PRO-INVEST CONSULTING - (hidden) Alt-Invest (firm ALT - (hidden) "Investor", "Analyst" (firm INEK) and other "closed" and "open" software packages. "Closeness" means impossibility of changes by the user of formulas and algorithms according to which calculations take place in a software package (Comfar, Project Expert packages). The "open" include packages implemented on the basis of spreadsheets in the appropriate environment, where the user has the ability to modify formulas [1].



**Fig. 2.** Innovation and investment activities in the conditions of transformation processes at domestic enterprises [15]

Investments in innovative projects can really change the quality of life of people, give impetus to further intellectual development, the ability to solve non-standard problems. Therefore, it should be borne in mind that the implementation of the investment project may be not only economic effect, i.e. profit, but also important social, reputational effects, increasing brand prestige, customer loyalty, increasing staff competence, i.e. increasing the value of the company through intangible assets, which include in particular intellectual and human capital.

Therefore, considering the directions of investment decisions, investments in human capital become especially important. The authors propose to use the capabilities of neural networks for accounting and evaluation of human capital, as a key factor in supporting decision-making that would ensure the successful operation of the enterprise. According to the authors, when evaluating investment decisions should choose those that, among other things, lead to the harmonization of human relations and organizations develop creative abilities, so that their creative behavior is organized by the use of limited resources in harmony with natural processes. That is, it is necessary to motivate the generation of new ideas and relevant goals. The information system must, on the one hand, assess the significance and quality of investment in innovation in comparison with the goals that were originally set. On the other hand, he must be able to formulate a conclusion in such a way that it contains an incentive to start creating a new innovation, i.e. the process of developing the level of creative achievement must be continuous [17]. This is the fundamental difference between the proposed solutions for improving the information system from traditional systems, continuous stimulation of creative motivation.

## **Conclusions**

1. The essence of investment definition is studied and specified. Their classification is analyzed. Features of investments at different levels of economic and practical activity and in different sections of science are determined. The logic of making investment decisions at the macro level and modern

aspects of investment areas and approaches to assessing their effectiveness are determined.

2. The directions of further researches with use of scientific methods of the economic theory in the field of investment are formulated.

3. Neural networks and the possibility of their implementation in the information system of the enterprise are investigated. A scheme for evaluating investment decisions in the process of innovation management has been developed, which includes a subsystem of analysis and forecasting based on neural networks. Also takes into account the assessment of investment in human capital. Such a system will ensure more informed decisions, eventually leading to an increase in the value of both tangible and intangible assets of the enterprise.

4. It is proved that the ability of NN to learn on the basis of input data on innovation and investment projects will allow the trained neural network to make estimates of investment project indicators, take into account the risks of implementation and consequences of the project, which allows to take appropriate measures to minimize them.

5. Upgrading the information system of the enterprise in accordance with the modern development of information technology will lead to more informed investment decisions and on this basis to obtain greater profits of the company, which will ensure sustainable development of the enterprise, based on competitive advantages and increase and increase human capital.

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