МЕНЕДЖМЕНТ

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USE OF THE URBAN LOGIC THEORY WITH DEVELOPMENT PROJECTS MANAGEMENT

Urgency of the research. *The study of the methods of economic and financial evaluation of the effectiveness of development projects is an underdeveloped area of economic knowledge, due to the impossibility of predicting the obstacles associated with investments in the future, and the implementation of such projects is most often associated with risk and uncertainty.*

Target setting. *Therefore, in this case, it is proposed to use fuzzy logic theory, which defines a modern approach to describe business processes that present uncertainty and inaccuracy of the source information.*

Actual scientific researches and issues analysis. *The question of using the theory of fuzzy logic in the management of development projects is highlighted in the scholarly works of Ukrainian and foreign scholars such as Asai K, Borisov A. N., Gordienko I. V., Semenenko M. V., Mityushkin Yu. I., Mokin B. I. and others.*

Uninvestigated parts of general matters defining. *Known studies have shown that classical control methods work quite effectively at fully deterministic control objects and environments, and for systems with incomplete information and high complexity, fuzzy analysis methods that are optimal to be adapted to a modern project management system for constructing an integrated neural network are optimal.*

The research objective. *The task is to use the fuzzy models to move on to the development of modern management technology with the use of artificial neural networks to integrate the enterprise management system and development projects.*

The statement of basic materials. *The transition from traditional control systems to systems with fuzzy logic occurs using fuzzy variables. Let's consider the process of neural network modeling in the integration of enterprise management systems and development projects for the construction of a single integrated enterprise management system.*

Conclusion. *In this paper we propose a methodology for the implementation of investment projects for the implementation of information systems based on fuzzy-plural approach, which allows to take into account qualitative aspects that do not have an exact numerical evaluation.*

Keywords: *fuzzy logic; control systems; project management; neural network.*

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ВИКОРИСТАННЯ ТЕОРІЇ НЕЧІТКОЇ ЛОГІКИ ПРИ УПРАВЛІННІ ПРОЕКТАМИ РОЗВИТКУ

Актуальність теми дослідження. *Дослідження методів економічної та фінансової оцінки ефективності проектів розвитку являє собою недостатньо вивчену область економічних знань, що пов'язано з неможливістю передбачення перешкод, що пов'язані з інвестиціями в майбутньому, і реалізація таких проектів найчастіше пов'язана з ризиком і невизначеністю.*

Постановка проблеми*. В данній роботі, пропонується використовувати теорію нечіткої логіки (Fuzzy Logic), що визначає сучасний підхід до опису бізнес-процесів, в яких присутня невизначеність і неточність вихідної інформації.*

Аналіз останніх досліджень і публікацій. *Питання використання теорії нечіткої логіки в управлінні проектами розвитку висвітлено у наукових працях українських та зарубіжних науковців, таких, як Асаї К, Борисов А. Н., Гордієнко І. В., Семененко М. В, Мітюшкін Ю. І., Мокін Б. І. та інших.*

Виділення недосліджених частин загальної проблеми. *Відомі дослідження показали, що класичні методи управління досить ефективно працюють при повністю детермінованому об'єкті управління і середовищі, а для систем з неповною інформацією та високою складністю оптимальними є нечіткі методи аналізу, які слід адаптувати до сучасної системи управління проектами для побудови інтегрованої нейронної мережі.*

Постановка завдання. *В роботі поставлено завдання використовуючи нечіткі моделі перейти до побудови сучасної технології управління із застосуванням штучних нейронних мереж інтеграції системи управління підприємством та проектами розвитку.*

Виклад основного матеріалу. *Перехід від традиційних систем управління до систем з нечіткою логікою відбувається з використанням нечітких змінних. Розглянемо процес нейромережевого моделювання при інтеграції систем управління підприємством та проектами розвитку для побудови єдиної інтегрованої системи управління підприємством.*

Висновки. *У даній роботі пропонується методика реалізації інвестиційних проектів впровадження інформаційних систем на основі нечітко-множинного підходу, який дозволяє враховувати якісні аспекти, які не мають точної числової оцінки.*

Ключові слова*: нечітка логіка; системи управління; управління проектами; нейромережа.*

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Urgency of the research. The study of economic and financial evaluation methods of the development projects effectiveness is an underdeveloped area of economic knowledge. This is due to the fact that it is impossible to predict in advance all the obstacles associated with investments in the future, and the implementation of such projects is most often associated with risk and uncertainty. In many respects, such problems are associated with insufficiently complete and qualitative consideration of the associated risks.

Target setting. It is well known that the investment project management system has a high degree of uncertainty with changes in a large number of factors of influence and constantly changing performance parameters. Therefore, in this case, it is proposed to use fuzzy logic theory, which defines a modern approach to describing business processes that present uncertainty and inaccuracy of the source information. The decision-making process in this case is multidimensional and extremely complex and requires the involvement of modern software tools, which allows more accurately, in comparison with other methods, to determine the level of risk and significantly reduce the time for appropriate calculations.

Actual scientific researches and issues analysis*.* It is shown in reference [1] that the basis of the false logic of formalism is the notion of fuzzy sets and fuzzy statements, the main difference of the method is the introduction of linguistic variables (subjective categories) - variables that can not be described with the help of a mathematical language, that is, it is difficult to give them precise (objective) quantification. In the literature, fuzzy sets of linguistic variables are also called term sets [2; 3]. Fuzzy logic also introduces the concept of fuzzy function and developed the concept of constructing fuzzy regression models. Within the framework of such an approach in the management of development projects, the meaning of a fuzzy linguistic variable can be expressed in terms of type "low", "moderate", "large", "very high", etc. [4; 5]. The set of values of the fuzzy variable form the so-called term-set. For example, "The level of investment in a project" may be set by the term set of values such as {Very Low, Low, Medium, High, Very High}. In the approaches of building an integrated enterprise management system and development projects and principles of neural network modeling of integration processes are presented.

Uninvestigated parts of general matters defining. Known studies have shown that classical control methods work quite effectively at fully deterministic control and deterministic environments, and for systems with incomplete information and high complexity of an object of management optimal are fuzzy control methods that need to be adapted to a modern project management system for building an integrated neural network.

The research objective. The task is to use the fuzzy models to move on to the development of modern management technology with the use of artificial neural networks to integrate the enterprise management system and development projects.

The statement of basic materials. In Fig. 1, and shows the areas of the most effective use of existing management technologies [6]. We will conduct a schematic analysis of existing and perspective project management systems for integrating systems into a single information management complex of complex objects. In accordance with Fig. 1, and we will analyze existing management systems for enterprises and development projects. Consider the classic methods of enterprise management, among which should be distinguished pyramid enterprise management, which is shown in Fig. 1, b [7]. We distinguish it in four levels: strategic decision making, tactical management, operational control and grassroots level - the level of control system of the TP.

Users of the information level of making strategic decisions are the owners of companies and top managers. It describes and optimizes the basic business processes of enterprises, identifies the organizational structure and the main personalities responsible for one or another procedure. Users of tactical control level are middle and top level managers who take tactical decisions in the field of finance, production, logistics and others. The most important functions of this level are planning and budgeting. At the technological level, data is gathered from the shop equipment and processed and summarized.

It should be noted that the processes of managing innovation and investment projects mostly occur at the level of tactical and operational management, so consider the tasks that solve the ERP and MES systems (Fig. 2). The level of tactical management represented by ERP-systems. At each of the listed levels there is a software and hardware complex, which in one way or another solves the problem of production management. Unfortunately, there is no software that will fully cover all aspects of production management. Therefore, for the implementation of a certain set of functions, it will be necessary to use several information systems closely integrated with each other.

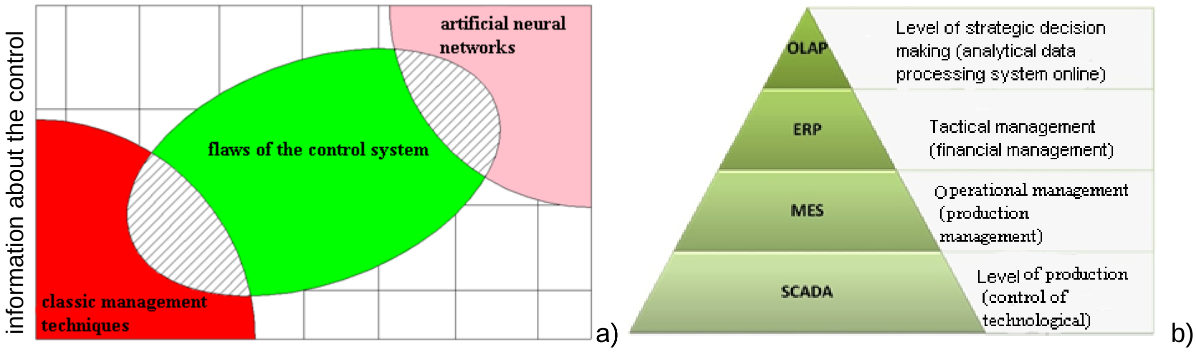

Fig. 1. Methods of enterprise management: a) transition from classical control methods to neural networks; b) pyramid management

Usually, ERP (Enterprise Resource Planning) systems consist of different modules that implement the needs of organizations in the process automation. Each of the modules is oriented to a specific area of business or business process. In the composition of the modules used, the structure of the ERP system can be divided into two components: basic and advanced elements. The basic elements are all the functions of the system that control the production, and the extended elements include all the functions that ensure the work of production. Typically, these elements are implemented as separate modules.

Fig. 2. Structure of ERP and MES systems

Since ERP systems have emerged as a result of evolutionary development of systems of the previous generation, they contain elements of MRP and MRP II systems (Tab. 1).

Table 1

Development of the main functions of enterprise management systems

	MRP	MRP II	ERP
Main functions of enterprise management systems	- product specification management; - inventory management; - management of production orders; - Preparation of the production schedule; - control and production management; - managing the needs of materials.	- all MRP functions; - financial management; - resource planning; - production planning; - sales planning - management of consumer orders; - development of the basic production plan; - volume planning of production.	- all functions of MRP II; - business planning and financial modeling; - Planning and management of marketing and sales; - resource management and modeling needs; - production management and production modeling; - management of resources and supplies.

The ERPII class subsystems are understood as WEB applications integrated with the enterprise's main ERP application that implements a distinct front-office in relation to the traditional ERP system. The system may belong to the ERPII class if the front-office and back-office are a single entity:

$$ERP2 = ERP+CRM+SCM+PLM+PDM+APS, \quad (1)$$

where: CRM systems: (Customer Relationships Management) -content management with customers; SCM class (Supplychain management) - automated supply chain management systems; PLM class systems (Produc tLifecycle Management) - product lifecycle management; system of class of PDM (Product Data Management) - management of production data; APS (Advanced Planning / Scheduling) systems-Advanced planning of production tasks.

The level of operational management is realized with the help of MES-systems. The main difference between MES and ERP lies in the fact that the MES-systems, operating exclusively from production information, make it possible to correct or completely recalculate the production schedule during the work shift as many times as necessary. Due to the rapid reaction to current events and the application of mathematical methods to compensate for deviations from the production schedule, MES-systems allow optimizing production and making it painful. MES-systems, collecting and summarizing data from various production systems and technological lines (lower level of the pyramid), lead to the highest level of organization of all production activities, from the formation of the production order and to the shipment of finished products to the warehouse.

The International Association of Manufacturers of Production Management Systems (MESA) has identified eleven generic MES-system functions: State Control and Resource Allocation (RAS); operational / detailed planning (ODS); dispatching of production (DPU); document management (DOC); Data Collection and Storage (DCA); Human Resources Management (LM); product quality management (QM); production process management (PM); maintenance and repair (MM); product history tracking (PTG); performance analysis (PA).

The transition from traditional control systems to systems with fuzzy logic can be shown on the basis of Fig. 3, and [1; 2]. The following fuzzy variables are used in the management of innovation and investment projects [4]: Net present value (NPV), Internal Rate of Return (IRR), Project Payback Time (ROI), ARR, Index of Return on Investment (PI) (Tab. 2). The value of the output variables determines the probability of the project being adopted. All variables except PB and ARR were characterized by the term set of values {low, low, mid, and high}. Variables PB and ARR described trapezoidal function of belonging and for projects with a payback period of less than 5 years or the rate of profitability of more than 20% had a logical value "Yes" (yes).

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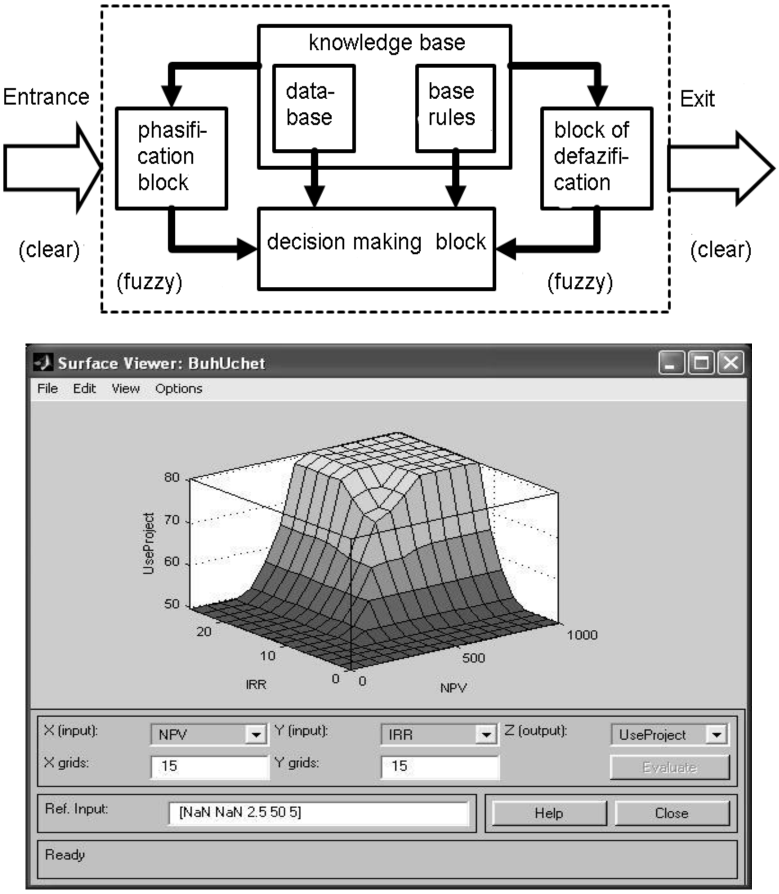


Fig. 3. System of fuzzy output: a) scheme of the system; b) An example of rendering the result of computations in MATLAB to assess the effectiveness of the project

One of the advantages of the Fuzzy Logic subsystem of the MATLAB computing system is the ability to visualize the results in the form of two-dimensional and three-dimensional graphs. An example of the result surface in the IRR and NPV coordinates is shown in Fig. 3, b. The resulting surface graph can be rotated by viewing it from different angles. The graph clearly highlights the area of "failure" of the project's effectiveness. In this case, it is obvious that the probability of an effective implementation of the project is rather high (71.8%).

Table 2

Bringing the indicators of investment analysis to fuzziness

Indicator	Interposition in terms of fuzzy logic
1	2
$PB = \frac{IC}{CF_{cp}}$	IC - the total amount of investment in the project can be accurately estimated; CFsr - the average annual financial flow from the project implementation can not be accurately estimated
$NVP(N,r) = \sum_{n=0}^{N} \frac{CFn}{(1+r)^n} - \sum_{n=0}^{N} \frac{IC_n}{(1+r)^n}$	CFn- the income achieved in the periodtime n can not be accurately estimated; ICn - the amount of investments in the n-step can not be estimated reliably; N - the estimated period of estimation is uncertain precisely; r - discount rate varies depending on external conditions.

Continuation of Table 2

1	2
$ARR = \frac{PR_{cp}}{(IC - LV)/2} * 100\%$	PRsr - the average annual profit of a project can not be precisely determined; IC - investment costs can not be estimated accurately; LV - Liquidation value of fixed assets.
$PI = \sum_{t=0}^{T} \frac{P_t}{(1+r)^t} : IC$	Pt - the sum of the given incomes can not be estimated reliably; ICn - the amount of investments in the n-step can not be estimated reliably;
$DPI_2 = \frac{\sum_{n=0}^{N} CF_n /(1+r)^n}{\sum_{n=0}^{n} IC_n /(1+r)^n}$	CFn - the income achieved in the periodtime n can not be accurately estimated; ICn - the amount of investments in the n-step can not be estimated reliably; r - discount rate varies depending on external conditions.

Considering the transition from existing to new systems of fuzzy logic in project management, the following should be taken into account. Neural networks are convenient for image recognition tasks, but very uncomfortable to explain how this recognition is performed. They can automatically acquire knowledge, but the process of their training is often slow enough, and the analysis of the trained network is very complex (the trained network is usually a "black screen" for the user). In this case, the artificial neuron is an element that converts the vector input x into the scalar y output. The transformation is carried out in two stages: the activity level of the neuron is calculated - the scalar product of the neuron weights vector w = (w1, w2 ... .wn) and the input vector x = (x1, x2 ... .xn) and the activation function f is applied to the calculated value, which is also is transmitting:

$$net = (w, x) = \sum_{i=1}^{n} w_i \, x_i, \qquad y = f(net) = f(\qquad (2)$$

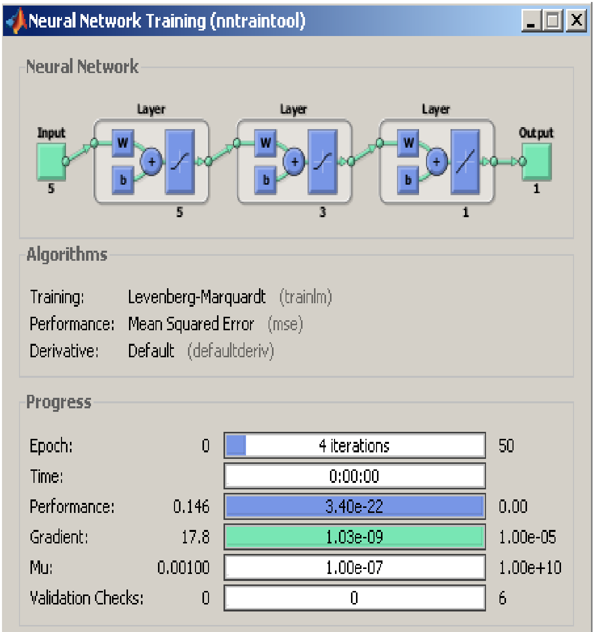
The combination of neurons forms a neural network, among which the most popular are the direct distribution networks. In them, the neurons are located in several layers - neurons of the same layer, receiving input signals from the previous, converting them and transmitting outputs of the neurons of the next layer. Hybrid neuro-fuzzy systems have found the greatest application. Their characteristic feature is that they can always be considered as systems of fuzzy rules, while setting the functions of accessories in the preconditions and conclusions of rules based on the training set is carried out with the help of a neural network.

Let's consider the process of neural network modeling in the integration of enterprise management systems and development projects, the algorithm of which is presented in. The main objective of the neural network modeling is the reproduction of actions that control the efficiency of the process of integration of the enterprise information system and development projects.

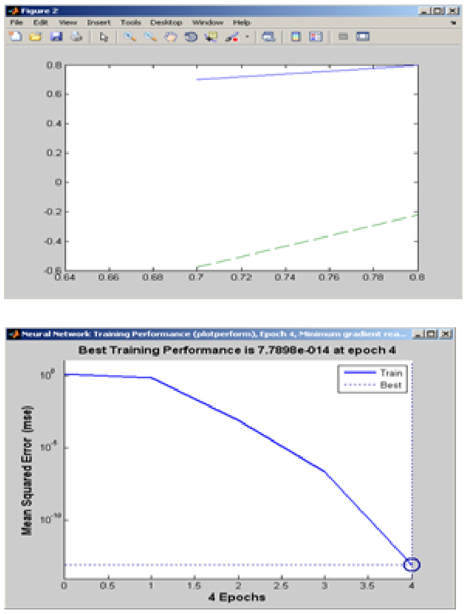
On the basis of the ratios considered in and the introduced main characteristics and parameters, it was determined that the management of the integration of information systems in the form of an optimal ratio of their inputs and outputs is determined by four groups of parameters: X - vectors of inputs of systems; Y - vectors of system outputs; Z - control vectors; R - control operators; λ, γ - auxiliary communication parameters. The neural network, created on the basis of [6] includes two modifications: "NMI1" and "NMI2" are built separately for the information systems of the enterprise and the project of development of the machine-building industry. On the basis of a definite tuple of input data, the structure of the four-layer neural network "NMI" was created - a network that simulates processes in the integrated information system (Fig. 4, a).

On the basis of the created network, its training was conducted and the processing of the results of work was carried out (Fig. 4, b) to determine the relationship between the inputs / outputs (Y / X) of the ICs with the control vectors (Z). The graphs show that the neural network after training with greater significance describes the processes of functioning of the system in the input / output space with the given control parameters (upper graph) than before the training (lower graph). The ratio of the results obtained before and after the training of the network shows that the process of training (training) of the network makes sense and the network more accurately describes the processes of transforming the inputs of the information system into outputs.

The numerical evaluation of the network learning outcomes is done by determining the magnitude of the Mean Squared Error (MSE) error, which was MSE =. Thus, based on the work of the neural networks for enterprise and project information systems, it has been proved that the systems can achieve their own effective work status with given control vectors for 5 and 7 epochs respectively (2.5 and 3.5 years).



a)



b)

Fig. 4. Neural network of the integrated information system: a) the correspondence of system parameters and goals (management) after training (horizontal axis - goal (control level Z), vertical axis - parameters (output level Y), b) training schedule of the neural network

Conclusions. In this paper, we propose a methodology for evaluating the effectiveness of investment projects for the integration of information systems based on fuzzy-multiple approaches, which allows for the consideration of qualitative aspects that do not have an exact numerical evaluation, which should significantly increase the adequacy of the applied methods. Despite the flaws and limitations of the theory, the fuzzy set method has been acknowledged as a promising number of major international companies such as: Motorola, General Electric, Otis Elevator, Pacific Gas & Electric, Ford, and others. Thus, the fuzzy set method is suitable for managing long-term projects, the implementation of which requires the use of parameters that are not clearly defined in time.

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