Modeling as an Intellectual System in the Field of Agriculture

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***Abstract*—The article presents the analysis of modern views on the concept of modeling, both from a practical and methodological point of view, from the standpoint of General scientific methodology. An attempt is made to understand the theoretical and philosophical aspects of modeling as a cognitive process in the field of agriculture. The main task of this work is to comprehend the role that can be played by visual modeling in the implementation of information technologies in the field of agriculture. As an example, the method of computer modeling to create a 3D model of the earth's surface and a simulation model of the business process. It is shown that in solving problems the model acts as an element of its optimization.**

Keywords—model, geometric-graphic modeling, simulation modeling.

I. INTRODUCTION

Modeling is a special kind of activity for the construction or selection of models for the knowledge of reality for a specific purpose. Modeling has practical content. Modeling as a method of scientific knowledge gradually penetrated into all areas of scientific knowledge, including: technical design, construction, architecture, astronomy, mathematics, physics, chemistry, biology, as well as Humanities and social Sciences [1]. In the article, the model is understood (from lat. modulus – measure of sample) of material or ideal object, which is considered to explore the original object (the original) and reflects the most important (from the point of view of the objectives of the study) the properties, qualities or parameters of the original [2]. Modeling is the construction of models of objects (objects, phenomena, processes) that exist in reality, i.e. the replacement of the real object with its suitable copy for the study of these objects of knowledge. The main feature of modeling is that it is a method of cognition with the help of substituent objects. The model acts as a kind of instrument of cognition, which the researcher puts between himself and the object, and with the help of which he studies the object of interest. Consequently, the modeling process includes three mandatory components: the subject (researcher), the object of study and the model that mediates the relationship between the cognizing subject and the cognizable object [3].

The fundamental theoretical basis of modeling is the concept of homomorphism and isomorphism.

II. HOMOMORPHIC AND ISOMORPHIC MODELS

A. Homomorphism in modeling

Homomorphism (from Greek "χόμο" - identical, common and «μορφή» - a form) – such ratio between two systems when the following provisions are carried out.

- To each element and each relation between elements of the first system there correspond one element and one relation of the second system (but optional on the contrary).
- -If for a number of elements of the first system some relation is carried out, then for the corresponding elements of the second system the corresponding relation □4. P.64□. Moreover, one system is called the original (prototype), and the other – homomorphic way (mapping) or model of the first system (homomorphic mapping of the simulated object). In this mapping, the similarity of the model with the original is always incomplete. The model only approximately reflects some properties (parameters) of the original. The original may have different homomorphic models.

B. Isomorphism in modeling

The isomorphism (from the Greek. "ίσος" - equal, "μορφή" - form) - the ratio between any two objects of the identical structure. There is a one-to-one correspondence between the elements of isomorphic objects: each element (and the relation between them) of one object corresponds exactly to one element (and the relation) of another object, and vice versa [4. P.64]. However, generally, model elements maybe two, and three etc. (for example, to a point of three-dimensional space there correspond two projections of this point and, on the contrary), but they have to be put in compliance only to one element. At an isomorphism one system can be model another and vice versa: the second system can be considered as model of the first system. In it the fundamental difference of an isomorphism from a homomorphism at which the uniqueness is supposed only in one party consists [5].

The distinction of homomorphic and isomorph models can be explained on the following example. The drawing of the topographical surface displaying the land surface on a classroom board and on the sheet of paper – isomorph on the relation to each other objects. But this drawing is homomorphic model in relation to the most land surface. The isomorph model displays a real more precisely, than homomorphic. However, at model operation of the difficult

objects, processes, the phenomena, in particular, at model operation of the land surface, use generally homomorphic models. It is bound first of all to complexity of display of the original leading to simplification of model. Model operation – one of the main ways of a research of the phenomena and processes of an environmental real. It is based on the principles of analogy and similarity and is bound to such categories as abstraction, a hypothesis, etc. [6]

III. Classification of Models in Applied Aspect

There is a large number of classifications of models to which there correspond particular types of model operation. There is no standard point of view in this question yet. The author in the research presented models which differ: 1) on specific sign – the material, ideal, object, symbolical; 2) in an expression form – mechanical, logical, mathematical; 3) on an object of research – physical, chemical technical, physiological, etc.; 4) by the phenomenon nature – social, economic, biological, psychological, molecular, quantum, etc.; 5) on research problems – heuristic, prognostic; 6) on a degree of accuracy – confidants, precise, reliable, probability, etc.; 7) on volume basis – the complete and inexact; 8) on a way of expression – sign, real, graphic; 9) on properties of display – functional, informational, systemic[6].

The author of the article proposes the use of visual-figurative (iconic) models for the needs of agriculture. Visual-figurative (iconic) modeling allows you to design a model that represents the object under study analog (similarity). This model behaves like a real object, but does not look like one (all sorts of drawings, diagrams, transmitting in a visual form the structure or other features of the simulated objects). The most important type of iconic modeling is geometric modeling and its variety – geometric-graphic modeling. In recent years, a special type of computer modeling – simulation (from English. simulation modeling) involves the simulation of a real process and includes both the process of creating a model and its study using computer technology.

A. Geometric-Graphic Modeling

Geometric-graphic model is an approximate representation (image) of any set of objects, phenomena of the outside world in the form of a set of geometric varieties and relations between them to gain new knowledge about another object (original). In a geometric model can be displayed elements of different dimensions (in any combinations and relationships with each other), having its own internal structure [7]. Geometric models include the quantitative relationships of the model elements. These are quantitative characteristics of geometric figures obtained as a result of measurements. This functional dependence between the model parameters and their analytical generalization, associated with derivatives, integrals, etc. This algebraic expression to the numerical implementation of quantitative (and qualitative) regularities (properties) of the model, and, consequently, the real and the simulated object. At the same time, geometric modeling is directly related to mathematical modeling.

Thus, geometric modeling allows using geometric transformations to explore the spatial (spatially-like) forms, relationships (quantitative and qualitative), patterns, properties inherent in the objects of the real world.

B. Simulation Modeling

A simulation model of a real process (object, phenomenon) is called a computer program of this process together with an algorithm that describes the course of this process. Simulation simulates the behavior of the system over time. The advantage is that in the model you can control the time, namely if the process is fast, slow it down, and if the process is slowly changing, then speed up the time. Simulation models appeared in connection with the development of the digital age, information technology, which allowed to introduce the production of unique products, objects, performed computer simulation, to make real experiments. The purpose of simulation is to reproduce the behavior of the system under study on the basis of the results of the analysis of the most significant relationships between its elements or in other words–the development of a simulator of the subject area under study for various experiments [8].

There is no general point of view in the literature on what is meant by simulation model. There are different interpretations:

- Simulation model is mathematical model in the classical sense;
- A simulation model is a model in which random impacts are simulated in one way or another;
- The simulation model differs from the usual mathematical model by a more detailed description. However, the criterion by which one can say when the mathematical model ends and the simulation begins is not introduced.

The link between simulation models and process models is the possibility of converting the process model into an incomplete simulation model. The simulation model provides more information for the analysis of the system, in turn, the results of such analysis can cause modification of the process model.

Simulation modeling is one of the basic tools for designing complex economic systems and business processes. Simulation modeling allows to integrate mathematical and geometric (visual-figurative) methods with practical and theoretical experience of practitioners.

IV. The Use of Modeling in Agriculture

The author of the article proposes the use of at least two models for the sphere of agriculture. The first model is a geometric-graphic model of the earth's surface. Since agriculture has always been associated with agriculture. The second model is a simulation of the business process of product promotion on the market.

A. Geometric-Graphic Model

Modern means of computer modeling allow us to obtain from two-dimensional models of the earth's surface “Fig. 1 " 3D visual-shaped solid-state geometric-graphic models and solve professional problems on these models [6]. With the help of lofting modeling technology present such a model “Fig. 2".

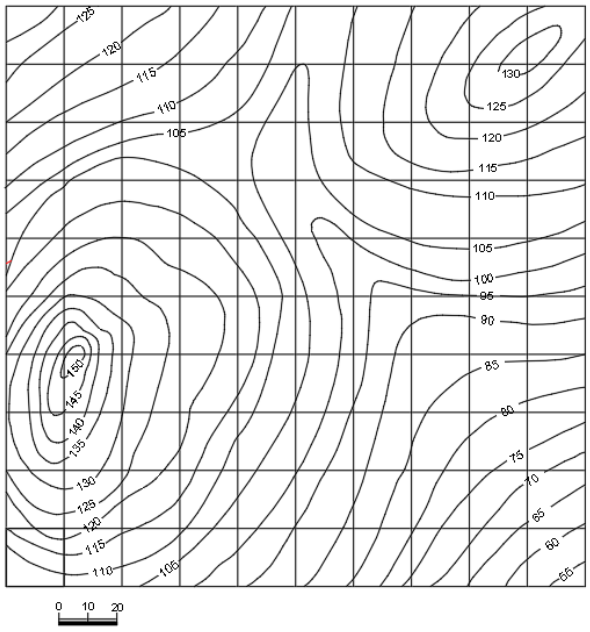

Fig. 1. Plan topographic surface-geometric-graphic model of the earth's surface

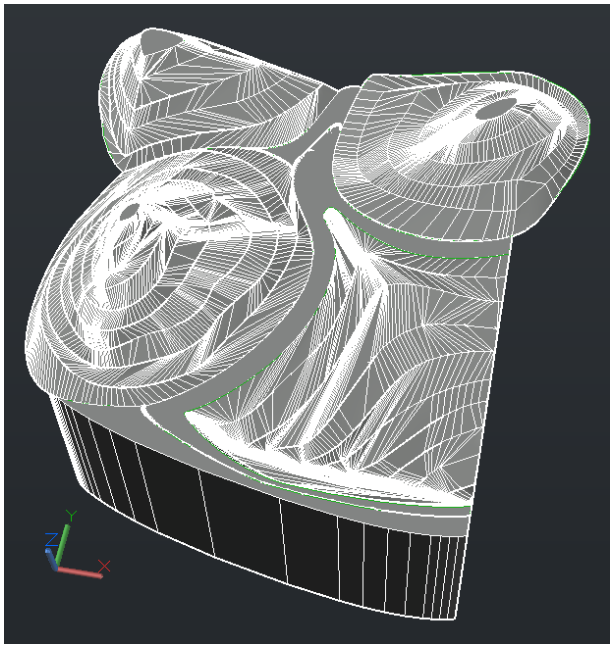

Fig. 2. Geometric-graphic 3D model of the earth's surface

B. Simulation Model

Simulation (computer) modeling of economic processes is used to manage a complex business process. The simulation model of the managed economic object in this case is used as a tool implementing the control system created on the basis of information technologies. In addition, the simulation model is used in the case of experiments with complex economic objects. Moreover, the simulation model of a managed economic object in this case is used to obtain and monitor the dynamics in emergency situations involving risks [9]. As an example, we present a simulation model of advertising product promotion. Since any economic activity is now associated with mass communications, and advertising is part of them. Therefore, the sphere of agriculture should not be limited by such business processes. The simulation model includes the following main elements: 1) sources and targets; 2) queues; 3) equipment.

Figure " Fig. 3 "simulation modeling of business process "Creation of Advertising Product" is Shown.

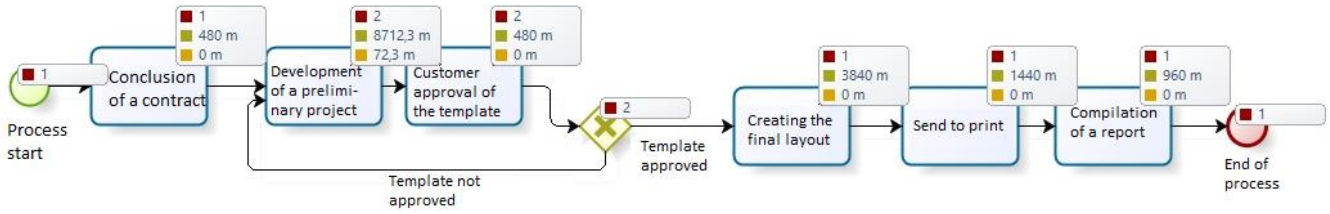

Fig. 3. The simulation modeling of business process "Creation of Advertising Product"

The author introduced the following parameters: 1) time; 2) resources; 3) cost. in Fig. 4 " you can see the time parameter filling. As you can see, one working day of 8 hours is taken into account. Next, on " Fig. 5 " shows filling in the cost parameter. And finally, on " Fig. 6" you can see the filling in of resources.

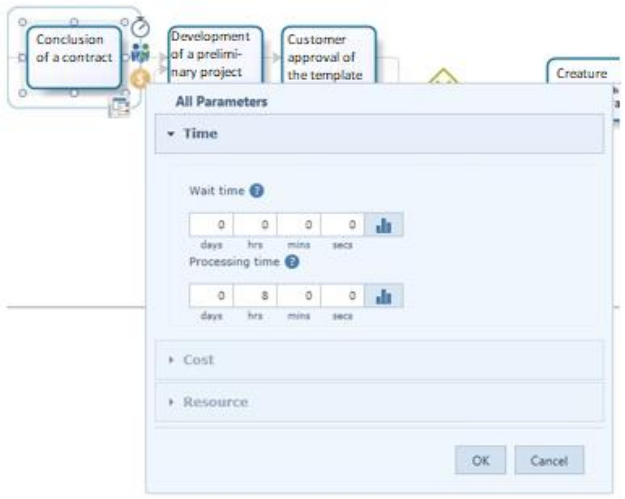

Fig. 4. Time parameter

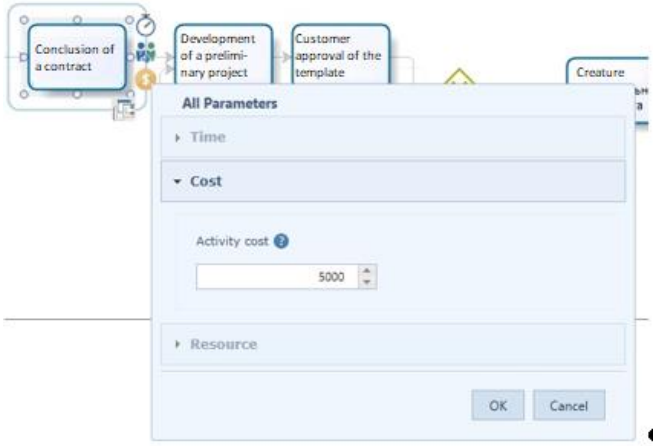

Fig. 5. Cost parameter

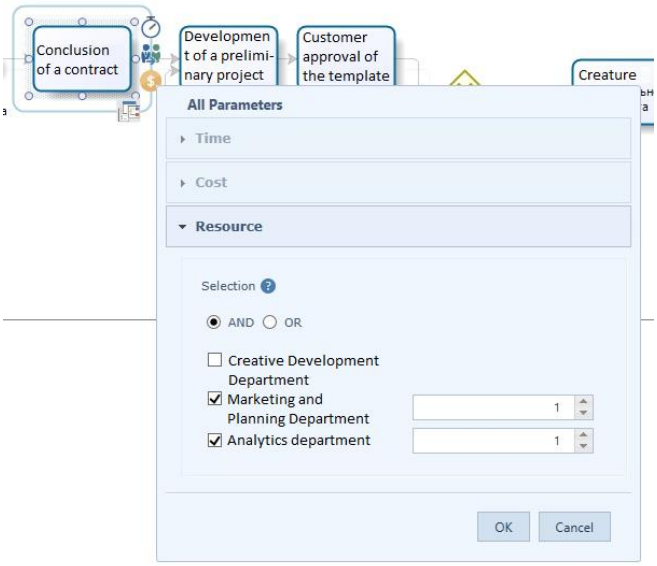

Fig. 6. Resource parameter

Further, all the data that we obtained in the process of simulation modeling were transferred to the table 1.

For a more detailed understanding of the execution time of the ongoing work, data on the duration of business processes were exported. This article does not show this table because it is large. It provides more detailed parameters that are analyzed and optimized.

TABLE I. DATA EXPORT

Resource	Utilization	Total unit cost	Total cost
Creative development Department	31,42%	102240	102240
Marketing and planning Department	18,14%	78720	78720
Analytical department	1,90%	7200	7200

Thus, simulation modeling is an integral part of business process analysis. Based on the simulation model of the business process, it is possible to simulate the actions of the system and analyze how this business process will work in reality and how much it will cost.

ACKNOWLEDGMENT

Currently, modeling is used in almost any activity. For each system can be created their models and for a specific purpose. Models should solve the tasks in a particular field of activity. Modeling should be carried out before the implementation of any project (technical, engineering, scientific, organizational, management, etc.). Modeling is one of the most appropriate adequate and reliable methods of scientific research that allows the most objective and comprehensive analysis of many phenomena or processes in most Sciences with minimal losses and risks.

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