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# The Concept of Modeling. Methods of Demonstrating Models

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**ABSTRACT:** We use models instead of the original object when the experiment is hazardous, expensive, and inaccessible (unique, unobservable, etc.) at the disadvantage of space and time (long-term, very short-lived, extended). It is used and the model provides a lot of convenience to the user.

**KEYWORDS:** Model, experiment, technology, formulation, interpretation, simulation, analysis, digital, process.

## I. THE CONCEPT OF MODELING AND MODELING

The model is a substitute method for learning the actual object. Later, we will clarify this definition.

Instead of the original object, the model is used in cases where the experiment is risky, expensive, impossible at unique levels of space and time (long-term, very short-lived, extended), impossible, unique, unobservable.

We describe it as follows:

• "risky experience" - it is better to use a person's model instead of acting in an aggressive environment; for example, the moon-moving robot;

• "expensive" - Before using the idea in the real economy of the country, it is better to test it in the mathematical or imitative model of the economy, taking into account its pros and cons and having an idea of the possible consequences;

• "long-term" - corrosion study-process, decades of occurrence - more profitable and faster in the model;

• "short-term" - it is better to study the details of the metalworking process by exploding using this model, as this process is short-lived;

• "extended in space" - mathematical models are easy to study in cosmogonic processes, as real flights to stars are not possible (for now);

• "microscopic" - it is convenient to use their model to study the interaction of atoms;

"impossible" - it is often encountered in a place where a person is not already an object. .Important: modeling is closely related to design. Generally, a system is first developed, then tested, then the project is updated and tested again, and so on until the project meets its requirements. "Design-modeling" is always a process. At the same time, the cycle is spiral - with each iteration the project gets better as the model becomes more detailed and the description level more precise;

• "unique" is a rare occurrence unless the experiment is repeated; In this case, the model is the only way to investigate such events.

• "invisible" - the model allows you to look at the details of the process in its intermediate stages; in modeling, the researcher must describe the causal relationships that allow us to understand everything in a system, in a system. In science, the system plays a formative and meaningful role, allowing us to understand the phenomenon, the structure of the object being studied. It is difficult to understand the logic of the system without creating a model. Requires an explanation of the system, the causes of events, the interaction of components.

The modeling process is the transition from a real domain to a virtual (model) model, after which the model is studied (self-modeling) and finally the results are interpreted as a reverse transition from the virtual domain to the real one. It replaces frontal or intuitive problem solving in the real field, namely, modeling technology, which involves three stages: formalization, modeling, interpretation. (picture 1.)

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Figure 1.1. Modeling process (main version)

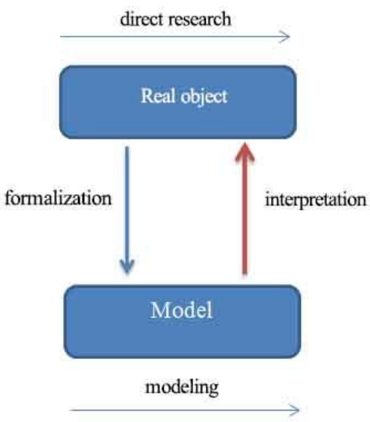


Figure 1

## II. TOOLS AND TECHNOLOGIES FOR MODELING.

**Models** need continuity, version tracking tools, and so on, that is, modeling requires a tool and relies on technology to create and improve models.

**Instrumentation** is a common tool that allows you to achieve real results and to reduce the cost of intermediate operations (paintings, standard libraries, masters, gauges, rubber bands ...).

**Technology** is a set of standard methods and techniques that use these tools at a predetermined price at a predetermined price, but which can achieve a guaranteed quality result when filing and applying.

**The environment** is a set of workspaces and tools that support storage and modification, project continuity, and the interpretation of facilities and systems.

Sometimes models are written in programming languages, but this is a long and expensive process. You can use mathematical kits for modeling, but experience shows that they usually do not have many engineering tools.

The model, given its ability to modernize, has some disadvantages, for example, low code execution rates. But there are undoubtedly advantages. you can do something again.

Modeling is an engineering science, problem solving technology. This note is very important. Technology is a way of achieving results in time and cost guaranteed with a previously known quality because it is modeled as a discipline:

O'rgan Learns how to solve problems, that is engineering science;

 It is a universal tool that guarantees the solution of any problems, regardless of the sphere.

Relevant modeling disciplines: programming, mathematics, operations studies.

Programming - because most of the time the model is done in an artificial environment (plastilin, water, brick, mathematical expressions ...) and the computer is one of the most commonly used storage tools. Algorithm is one of the ways to represent ideas, processes, events in an artificial computing environment with a computer (background Neumann architecture). It can be used to describe programming from a standpoint. If programming the object's features is easy, then programming is difficult. If programming environment is not based on background Neumann architecture, programming is almost useless.

What is the difference between the algorithm and the model?

**Algorithm** is a problem-solving process, followed by a sequence of steps, and a model is a set of possible properties of an object. (Communication with other objects, prerequisites, constraints), then the researcher can be solved with the unknown. They are the product of the human brain, the mind capable of making a plan. The algorithm itself is a plan that is placed in a sequence of actions. and it is necessary to distinguish the mind that chooses the appropriate choice of behavior.

And so:

**model + question + additional conditions = task.**

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## III. DIFFERENT FORMS OF THE MODEL.

Depending on the researcher's way of thinking, the world view, and the algebra used, the models may take different forms.

Models can be as follows:

- ✓ phenomenological and abstract;
- ✓ active and passive;
- ✓ static and dynamic;
- ✓ discrete and continuous;
- ✓ deterministic and stochastic;
- ✓ functional and object.

**Phenomenological models** are strongly dependent on a particular phenomenon. Changes in moods often make it difficult to use the model in new conditions. This is because the model can be constructed in terms of similarity to the simulation of the simulated system. The phenomenological model implies an external similarity.

**The abstract model** replicates the system from the point of view of its internal structure, replicates it more accurately.

**Active models** interact with the user; Not only can they answer questions when asked by users, such as passives, but they also activate the conversation, reorientation it, and have their own goals. You give.

**Static models** describe events without development. Dynamic models track systems' behavior, so they use differential equations in their records, for example, over time.

**Discrete and continuous models.** Discreational models change the state of variables because they do not know the relationship between cause and effect, part of the process is hidden from the researcher. details.

**Deterministic and stochastic models** can be determined (this often happens for complex systems), in which the model is constructed using the notion of probability.

**Distributed, Structured, Concentrated Models.** If the parameter describing the property of an object has the same value at any point (can change over time!), Then it is a system with reduced parameters. they get different values at different points, they say they are distributed, and the model describing the object is distributed. Sometimes the model replicates the structure of an object, but the object's parameters are concentrated, then the model is constituent.

**Functional and object models.** If the description is in terms of behavior, then the model is built on a functional basis. If the properties of eq are described, then the model is object-oriented.

Each approach has its advantages and disadvantages. Different mathematical devices have different capabilities (power) to solve problems, different computational resources. One and the same object can be described differently. based on the fact that one or another idea should be applied correctly.

The above classification is ideal. Models of sophisticated systems are usually complex and use multiple images at the same time. If the model can be reduced to a single form of algebra already formed, then the model is much simpler to solve, To do this, the model should be reduced to canonical form in various ways (simplification, redistribution, etc.) to the already existing form of algebra, its methods. Algebraic, differential, graphical, etc. ), different mathematical devices are used at different stages of its research. Figure 1.1

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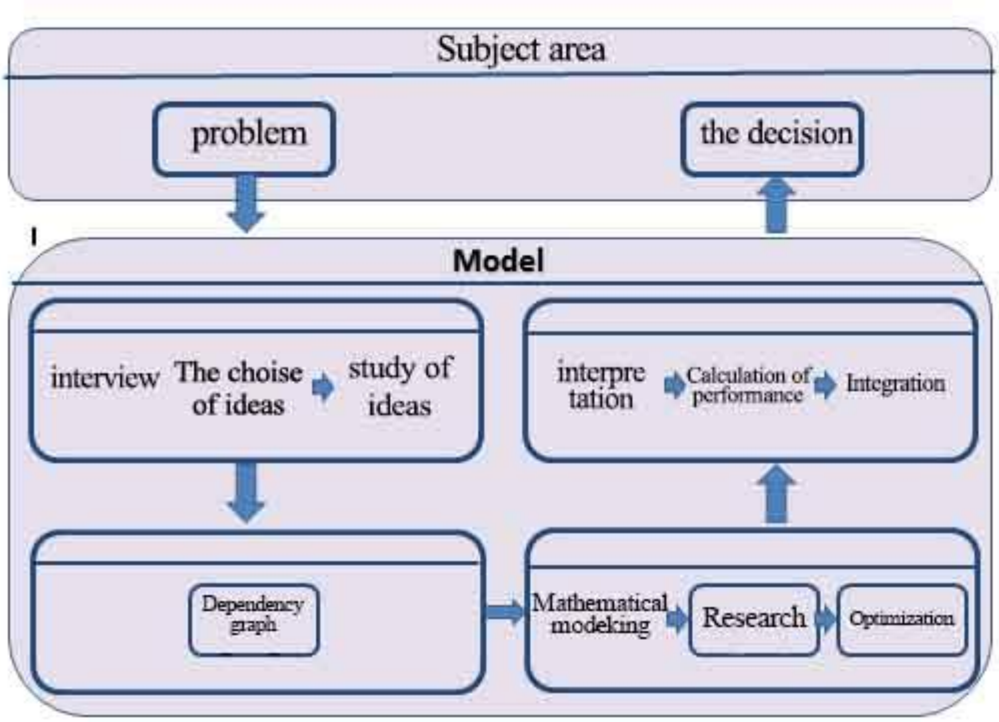


**The choice of modeling**

## IV.METHODS OF ANALYSIS

The developed mathematical model of the system can be studied in various ways - analytic or imitation. Using analytical methods, you can study the model in detail. It should be transformed into clear analytical dependencies. However, it is only successful for relatively simple systems. Analytical research methods are often used in the early stages of designing systems when there is insufficient data to initially roughly evaluate the characteristics of the whole system or its particular subsystems, as well as to create a more accurate model.

Imitation methods are the most universal way to study systems and calculate their performance characteristics. The method of imitation can be called algorithmic or operational. In the process of emulation, as in the original experiment, some events and conditions are recorded or output effects are measured, taking into account the performance characteristics of the system. You can implement any control algorithm or system performance using the algorithmic capabilities of a personal computer.

**Numerical Methods** - Numerical modeling only allows partial numerical solutions for certain initial conditions and quantitative parameters of the model. The methods of immunization vary depending on the class of systems under study, the method of model time propagation, and the system parameters and external influences.

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