SCIENTIFIC PROBLEMS AS A SYSTEM

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Abstract. The universal methodological approach is offered, allowing to transform of any scientific problem into the multilevel logical-hierarchical system. The universality of the approach consists in the fact that any scientific problem irrespective of the field of study can be broken into some structural blocs representing logically interconnected levels of research. The example of construction of logical-hierarchical structure of certain scientific problem is resulted. The basic features of new type of scientific perception of the world - systems thinking considered.

Key words: Methodology, multilevel logical-hierarchical structure, The system approach, structuring of a scientific problem, structural blocs, scientific categories, features of systems thinking

Physical phenomena and problems of economic management are not the only things that can be considered as multilevel, hierarchically organized Systems subject to Systems analysis. The systems approach, as a research methodology, allows for the transformation of any scientific problem into a System, thus revealing the structure and properties of scientific problems.

The general methodological principles of research as outlined above are universal. The methodology of the systems approach can effectively be used both in deciding large-scale economic problems and common student tasks (for example, in spelling or in dissertation work).

We shall consider the general scheme of presenting a concrete scientific problem using the systems approach.

For example we have to research *how to increase the profitability of producing grain in an enterprise.*

Before solving any scientific problem, we should first give it a scientifically valid formulation.

A *diagnostic analysis* is necessary for us to identify *the heart of the problem.* For this purpose, we should answer the following questions:

- Is there really a problem or it is something far-fetched and unscientific?
- If a problem really exists, is it urgent?
- How often does this problem occur, and what are the reasons for its occurrence?
- Does this problem have any connections with other problems?
- To what degree has this problem already been explored?

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- Can the problem be solved with resources available to the researcher?

- Whose interests touches the decision given problems? What obstacles can arise at decision given problems?

Answers to these questions allow us to understand the heart of the problem.

With reference to the problem of increasing crop production profitability, a diagnostic analysis of the enterprise's previous production allows us to formulate answers to the given questions as follows:

- *The problem* of profitability of manufacture as a whole, and of crop production in particular, really exists, because previous years may have seen very little or no profit at all.

- *The urgency of the problem:* the given problem is extremely urgent, as (the desirable) expanded reproduction is possible only at a certain level of profitability as determined by the relationship between profit and production costs.

- *The history of the problem*: this problem is common and is caused, first of all, by an increasing disparity between production costs and market prices for the crop in question; after years of changes in agrarian policy, this problem has become particularly aggravated by monopolies in the sphere of procurement and processing of crop production.

- *Connection with other problems*: the problem of production profitability is closely related to other macro- and microeconomic problems.

In particular, it is connected to the problems of: pricing of industrial means of production; the conditions ofhorizontal and vertical cooperation in the agrarian and industrial complexes; the development of mutual economic relations between manufacturers and suppliers of agricultural production with branches of processing; a decrease in production costs, etc.

The problem in question has been researched by many scientific institutes, but new research is necessary after the transition to a market economy.

- *Problem resolution* is quite possible with the available methodological approaches, developed scientific instruments, accessible information, and with the presence of labor, material and financial resources.

- Possibility and means of problem resolution undoubtedly infringes on the interests of certain subjects in the market economy. It is difficult to get reliable accounting and statistical information due to existence of "shadow" economy.

So, the heart of the problem has been formulated.

The most complex and important thing is the following stage of **structuring the problem.**

When we consider the management systems of economic enterprises, or biological systems, a hierarchical structure is usually evident or easily determined.

For example, a biological system can be characterized as such:

Organism → organs —* tissues → cells → sub-cellular structures

Economic system:

National economy (as a whole) → complexes (agrarian and industrial complex, etc.) → branches of a national economy (agriculture, energy, etc.) —* associations of enterprises (agro-firms, holdings, etc.) → enterprises → divisions of enterprise (brigades, individual farms, etc.) → the individual worker.

The levels of hierarchy in these examples are easy enough to distinguish.

Structuring a scientific problem is more difficult, as it is concerned with outlining prior knowledge, levels of research and the steps to solve the problem.

The universality of the approach consists in the fact that any problem can be broken into three large structural blocks representing three logically interconnected levels of research:

a) theoretical-methodological;

b) quantitative - analytical (empirical);

c) applied (pragmatic).

1) The **theoretical-methodological aspect of research** is the qualitative analysis of a problem. This includes the following structural elements as subsystems: a) methodology, b) categories, c) methods (as shown in the circuit):

Theoretical-methodological aspect of research

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Methodology —* Categories → specific methods

These structural elements are objectively necessary to conducting research of any problem irrespective of the field of study.

Let's consider the contents of the logical-hierarchical structure with reference to the problem of profitability.

a) All research is conducted within the framework of a certain scientific methodology. So, in the conditions of a planned economy, this methodology will be based on research of production costs within the framework of the general labor theory of cost; in the conditions of a market economy, the analysis will be based on the theory of limiting costs.

b) Revealing the **essence of scientific categories** always precedes the concrete empirical (quantitative) analysis. Determining the essence of the categories is necessary for constructing a system of parameters and accurately defining their measurement and methods of calculation.

In analyzing a problem of profitability, the essence of such market categories as limiting and average costs, price, alternative cost profitability of realization, etc. must be defined. A special technique will be used for this task.

c) The analysis of a problem requires the development of **a specific technique** of research which should correspond to the chosen methodology.

2) The **quantitative - analytical, or empirical aspect of research** is a logical continuation of the first aspect.

Often, if the urgency of a problem has not been proven by the diagnostic analysis and if the essence of the basic scientific categories has not been defined within the framework of the chosen methodology, then quite often the analysis of empirical data becomes meaningless exercise in statistics.

This aspect of research is formed by the allocation of subordinate levels of research which also form a hierarchy of logical elements.

As only empirical data can be processed at this stage, it is possible to allocate the following subsystems:

a) levels of parameters;

b) the basic tendencies in parameters change;

c) search for objective laws in empirical material;

d) factor analysis.

The logical-hierarchical structure of the second aspect of research can be presented as the following circuit.

Quantitative - analytical (empirical) aspect of research:

Levels → Tendencies → Factors → Laws

3) The **applied (pragmatic) aspect of research** is connected to the final achievement of the purpose of the given research problem.

In essence, at this stage the transition of a system from a former to a new condition is achieved. In other words, on the basis of the research conducted, a system of new qualities is created.

This aspect of research can also be broken into a number of subsystems:

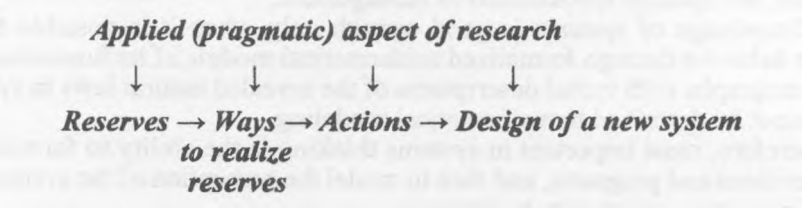
a) the reserves revealed during research;

b) ways of realizing the reserves;

c) specific actions;

d) forecast and design of the new system.

The logical-hierarchical structure is shown in the following diagram:

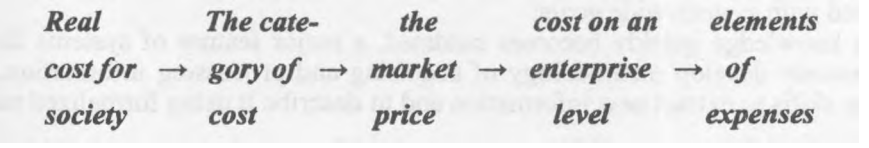


So, structuring a scientific problem as a system begins with the formation of the three considered aspects which are further structured into subsystems in order to research their interrelations and in order to establish the general logical-hierarchical structure of research.

Each subsystem can be further divided into new subsystems of more basic levels, for example with detailed elaboration on crops, kinds of production, annual yield dynamics, etc.

Thus, the structure of a problem can branch into categories, investigation phases, directions and methods of analysis. Moreover, from the point of view of the systems approach, scientific categories can be considered as multilayered concepts with a hierarchical structure.

For example, consider the general concept of **expenses** inherent in any public system at any stage of its development. Goods production is represented by the category of **cost** which, in turn, is manifested in the market through **price.** Furthermore, the basis of **the prime cost** of production is developed from concrete **elements of expenses.** This hierarchical structure can be represented as follows:



Each structural element is investigated by the specific research methods outlined for the problem in question, and it is therefore possible to construct a corresponding hierarchical structure of these methods.

Thus, the structuring of a scientific problem is a systematically developed plan of research where the sequence of logically interconnected subsystems and elements is untwisted as if in a logical-hierarchical spiral structure.

The Transformation scientific problem into System intends that researcher himself has a system thinking. We shall briefly consider the concept of the system thinking. How define the system thinking?

The systems approach is a new type of scientific thinking for specialists. The nature of perception and ways of thinking around the world are defined in each historical interval by the level of development of productive forces in society.

New technologies, new organizational forms of production, new ways of management and new economic relations in national economies necessitate the preparation of experts with new types of worldly scientific perception and thinking: ***systems thinking.***

The basic features of systems thinking are:

- The world is perceived as a multilevel, hierarchically organized system;
- Any specialist, irrespective of their field of study, uses systems; a new paradigm of preparation of specialists is their preparation as system managers;
- The management of any system is connected to revealing its structure, system properties, and specific mechanisms of management;
- Knowledge of systems is good enough only when it is possible to describe the system's behavior through formalized mathematical models of its functioning.

Monographs with verbal descriptions of the revealed natural laws in systems thinking often cannot be described in mathematical modeling.

Therefore, most important in systems thinking is the ability to formalize knowledge into algorithms and programs, and then to model the perception of the systems accordingly, thus giving us the opportunity to manage:

- research of systems in their full integrity and the interaction of their structural elements;
- Integral to efficient management is the processing of large amounts of information on the behavior of systems under our control. Therefore the integral element of systems thinking is the possession of modem information technologies and methods of formalizing algorithms and programs;
- The major feature of new types of thinking is the skill to estimate the place of the system in question within the general hierarchical structure and to take into account the global character of many problems and the possible remote consequences of decisions made, even at a local level;
- Of special interest is the consideration of the possible, or even probable, influence of accepted administrative decisions on environmental conditions;
- This new type of scientific thinking is inextricably related to the principle of optimization in the management of systems. This includes the skill to construct and perceive of systems with purposes and criteria of efficiency in view of the fact that decisions effective at a local level are not always effective at a system-wide level. Hence, local aims should be coordinated with system-wide goals;
- As knowledge quickly becomes outdated, a major feature of systems thinking is to continuously develop methodology of acquiring and processing information. That is, having the skills to extract new information and to describe it using formalized methods.

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Аннотация. Предлагается универсальный методологический подход, позволяющий представлять любую научную проблему в качестве многоуровневой логико-иерархической системы. Универсальность подхода состоит в том, что при исследовании любой научной проблемы, независимо от предметной области, можно выделить структурные блоки, как логически взаимосвязанные уровни исследования. Приводится пример построения логико-иерархической структуры конкретной научной проблемы. Рассматриваются основные черты нового типа научного мировоззрения - системного мышления.