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"Nowadays cybernetics has an increasing importance in the management of industrial and economical processes, in reducing the special productivity of man's work, in the overall progress of mankind".

NICOLAE CEAUŞESCU

from the Message addressed by the President of the Socialist Republic of Romania to the Third International Congress of Cybernetics and Systems.

The System of Scientific Research and Technological Development. Cybernetic—Economic Models of the System

Under the conditions of today's technical and scientific revolution, scientific research and technological development represent an essential factor in the increase of national income, of nation's general wealth and the people's welfare. It exerts an influence, at ever higher speed of response, on the phenomena and processes that take place within all the components of national economy's general cybernetic system. At the same time, the results of the scientific research and technological engineering intensify and amplify all the flows in the sphere of national economy. The system of scientific research and technological development is a system generating new knowledge, new products, manufacturing, processes, methods and techniques of production and labour organisation.

As a result of the designing activity carried out within this system, designs are drawn up for new investment objectives both from the manufacturing technologies point of view and thatf o constructions design one. In this way, by means of the solutions proposed, designing could bring its contribution to a curtailment of investment costs, to the introduction of some up-todate technological methods and to the reduction of raw material, material, fuel and energy consumptions, as well as to the rise in the quality of construction by finding the most efficient functional, constructive and architectural solutions.

The rapid progress of today's science and technique has led to an ever greater stress laid on their transforming role in the economic and social life, having deep implications as far as the production of material values and their manufacturing technology are concerned.

The present scientific and technical revolution takes place under the circumstances of science's turning into a powerful productive force. The real industry of inventions, licences and innovations, scientific research and technological development are the propelling force for the expansion of material production, generate the increase of national wealth and the population's welfare.

The role, the attributes and functions of the system of scientific research and technological development (Fig. 1.a) within the economic mechanism are ensured by the numerous connections it has with all the systems pertaining to national economy, as well as to world economy (Fig. 1.b).

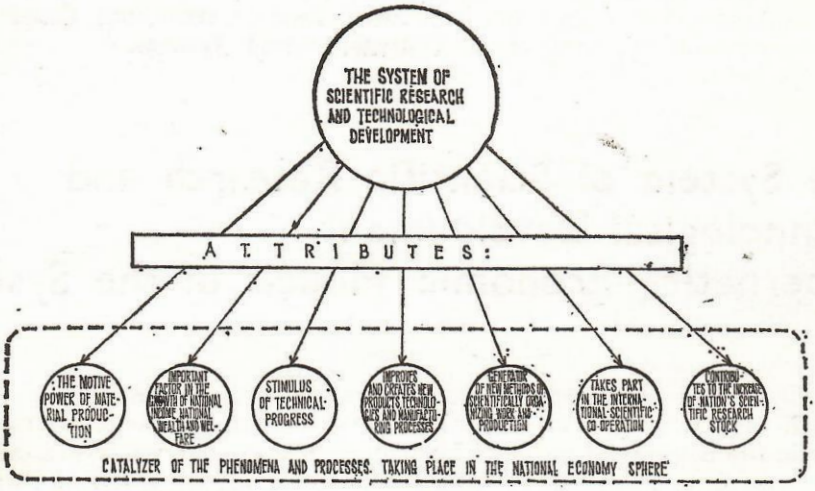


Fig. 1. *a*

The activities carried out within the system of scientific research and technological development exert a strong influence, by means of the system's output, on the nature, the inner connections and rates of all activities included in *the system of material production and services*, being one of the main stimuli of technical progress, a motive force of the entire productive activity. The output of the system of scientific research and technological development has implications on the objects and the means of labour, on the energy sources, on the structure along branches, groups of products and products etc., as well as on the improvement of the way the whole production process is being organized and managed.

In its turn, the system of material production and services gives an impulse to the system of scientific reserach and technological development both through the themes that result from everyday practice, which are to be later on studied, and through the complex installations and apparata

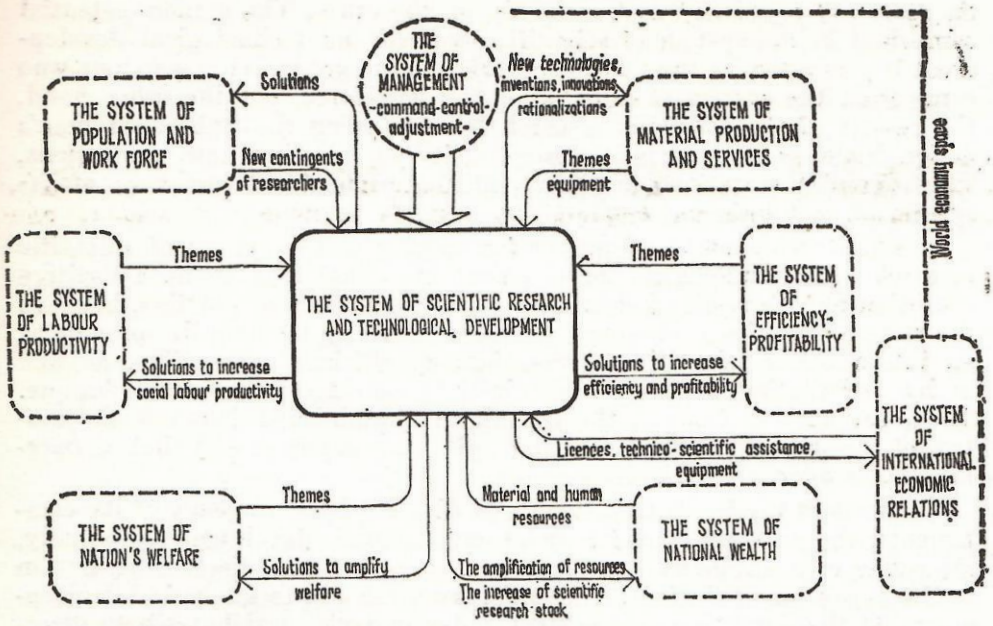


Fig. 1. *b*

produced for the optimal carrying out of the research work. It is thus stressed the direct connection and feedback that exist between the two systems, which lie in the fact that the system of scientific research and technological engineering can be developed only on the basis of the technical and material assistance provided by the system of material production and services; on the other hand, the dynamism of the system of material production and services is being stimulated by the practical application of the achievement obtained by the system under analysis.

Between the system of scientific research and technological development, on one hand, and *the systems of labour productivity and that of efficiency and profitability*, on the other, there establishes numerous strong connections. The evolution of the system of scientific research and technological development is very important for raising labour productivity, the profitability and efficiency of all the activities taking place in the field of national economy, acting on them through different channels, especially through the solutions which it advances with regard to the rise of the degree of labour technical equipment, *the production, mechanization, automatization and cybernetion, the labour processes scientific organization.*

Also, by means of the discovery of new materials and substitutes, of the solutions it puts forward as far as the efficient utilization of energy, of wastes are concerned and so on, the system of scientific research directly participates in the growth of the efficiency of the activities developed in all the compartments of national economy's general cybernetic system.

Intense direct connections and feedbacks exist between the system of scientific research and technological development, on one hand, and

the system of population and workforce, on the other. The human potential comprised in the system of scientific research and technological development is generated by the flows of workforce, the groups of researchers who come from the system of population and workforce. On the other hand, the results of the scientific research by expanding the sphere of man's action have as consequence the necessity of creating new professions, which implies mutations in the social and professional structure of the system of population and workforce.

The development and proper functioning of the system of scientific research and technological development are considered to be a decisive condition for the realization of a coupling as efffcient as possible, between the sphere of national economy and that of world economy by promoting an international scientific co-operation, as efficient as possible, as well as by assimilating the results obtained by world science and technique. Thus, emphasis is laid on the connections established between the system of scientific research and technological development and that of *international economic relations.*

Through the funds that it puts at disposal by the agency of its components, the national fund for social and economic development especially, *the system of social product and national income* brings a direct contribution to the expansion of the field of scientific research and technological development. At the same time, the system under analysis contributes both directly and indirectly, through the propagation effect, to the amplification of social product, to the growth of national income.

The system of scientific research and technological development directly influences *the growth of national wealth.* In this connection, the increase of the science and technology stock, constituent part of nation's creative potentialities, by efficiently turning to account the soil and subsoil resources, by discovering new energy, fuel and raw material resources, as well as by attaining ever more perfected technologies, that ensure the substantial reduction of specific consumption, the rise of the economic efficiency of production processes, the system of scientific research and technological development is an important factor as far as national wealth growth is concerned. Concomitently, *the system of national wealth*, by means of its components, particularly the nation's creative potentialities, helps to bring about the adequate functioning of the analysed system. Indeed, the higher the science and technology stock is the better is ensured one of the fundamental premises necessary for the dynamic development of the system of scientific research and technological development.

Powerful connections establish within the sphere of national economy between the system of scientific research and technological development, on one hand, and *the system of nation's welfare*, on the other.

In the first place, by the agency of the system of scientific research and technological development there opens up a decisive feedback to the growth of nations welfare, namely the one generated by the triad: *research-production-education* (Fig. 2). In the second scientific research through the results it achieves exerts a direct influence on the optimal carrying out of all social and cultural activities. Also, the system of scientific re-

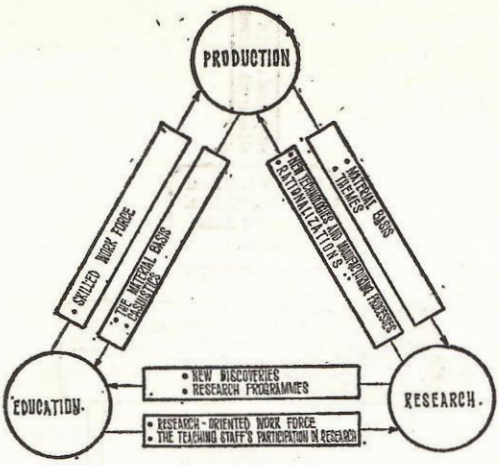


Fig. 2.

search and technological development has a strong impact upon the increase of the population's material and spiritual living standard, by creating new possibilities, new valences for the growth of nation's well-being.

The analysis worked out points out the major role that the system of scientific research and technological development plays in national economy's general topology. The role played by this system may be compared to that of a *catalyzer* of the phenomena and processes taking place within the national economy sphere.

Taking into account the complexity of the processes which take place within the analysed system, the great number of its interferences with the other components of national economy's general cybernetic system, with a view to determine the optimum growth trajectories of the system of scientific research and technological development arises the necessity of elaborating the following *classes of cybernetic-economic models* (Fig. 3):

a) assembly models of fixing the general growth tendencies of the system of scientific research and technological development and the correlation of its evolution to the general growth of national economy's general cybernetic system;

b) models of correlating the evolution of various domains pertaining to scientific research work to the development of the corresponding branches of material production. Emphasis particularly is laid on the analysis of the tasks set before scientific research and technological development in the priority branches which the general economic growth of national economy depend on: energy, iron and steel metallurgy, machine building, chemistry and so on;

c) models of optimally allocating human and material resources on domains of activity within the system of scientific research and technological development;

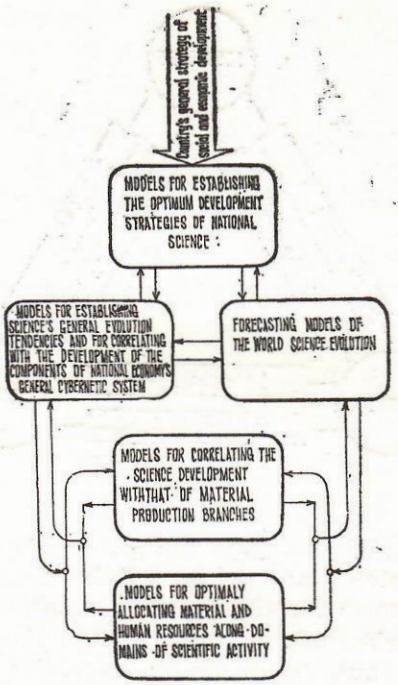


Fig. 3.

d) models of establishing the optimum development strategies for the priority branches in national science;

e) forecast models of establishing the general evolution tendencies of science all over the world;

f) models of setting-up the optimum forms and ways for the scientific and technical co-operation with other countries.

The topology and the connections of the system of scientific research and technological development stress the important part this system plays within the mechanism of ensuring the optimum balanced and proportional economic growth trajectories. The mathematical-economic models pertaining to the system of scientific research and technological development lay emphasis on the optimum ways of turning to account the nation's creative potential, the assimilation and promotion of technical progress by one's own efforts, as well as the international technical and scientific cooperation.