JPRS L/10444

9 April 1982

East Europe Report

ECONOMIC AND INDUSTRIAL AFFAIRS

(FOUO 3/82)

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EAST EUROPE REPORT

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INTERNATIONAL AFFAIRS

UDC 621.039.001

DEVELOPMENT OF CEMA NUCLEAR POWER SYSTEM VIEWED

Prague JADERNA ENERGIE in Russian No 12, 1981 pp 439-443

[Article by Yevgeniy P. Vlasov, International Scientific Research Institute of Control Problems, Moscow; Milos Dragny, Czechoslovak Atomic Energy Commission, Prague; and Yuriy A. Tyurin, Department of Scientific and Technical Cooperation of the CEMA Secretariat, Moscow: "A Study of Methodological Problems in the Forecasting and Optimal Development of a Nuclear Power System for CEMA Member-Nations"]

[Text] One of the important directions in solving the fuel-and-power problem of CEMA member nations is the accelerated development of the nuclear power industry. The present stage of the cooperation among these countries in this area is characterized by the large-scale and comprehensive implementation of measures, the considerable influence of scientific and technical progress on production efficiency and the great contribution of these countries to the overall issue of realizing the nuclear power-production portion of the long-term specific program of cooperation (DTsPS) to provide for the economically founded requirements of the CEMA member-nations for the basic types of power, fuel and raw materials to the year 2000. The indicated conditions for the development of the nuclear power industry are dictated by the necessity of improving methods of controlling and planning the development of the entire nuclear power complex (YaEK) of the socialist countries [1,2].

Figure 1 presents the interindustry structure of the nuclear power-production complex. It includes the fuel-cycle industries (extraction, processing and enrichment of fuels, the manufacture of fuel elements, chemical processing of spent nuclear fuel and processing and storage of radioactive wastes), nuclear stations and installations for the generation of electric and thermal power (nuclear electric-power stations, nuclear heat-and-power stations and nuclear power-production installations) and all capital-generating sectors of the nuclear power complex (metallurgy, heavy, chemical and power-engineering industries, the electrical equipment industry, instrument engineering, power industry construction and the construction industries).

Of course, the nuclear power complex of a given country can and must be considered a subsystem of the integrated nuclear power complex of the CEMA member-nations. It is possible to rationally solve problems which within the framework of a single country cannot be solved at all or, at least, cannot be solved efficiently. This can be accomplished through international cooperation, division of labor, specialization of production and construction through combined effort or cooperation within the scope of capital investment in construction.

The industries in the nuclear power complex are embraced by complex interrelationships, including reciprocal relationships (for example, the chemical processing of spent fuel). The formation of this aggregate of industries into a unified nuclear power complex is dictated by the degree of specialization, the influence they exert on one another as well as by the overall production cycle.

The characteristic integrity of the nuclear power complex which we have pointed out determines the necessity for applying a systematic approach to examining the prospects for its development and the introduction of methods for multisector planning and control.

The overall organizational structure for planning the long-term development of the nuclear power complex can be presented in the following manner (fig. 2). This diagram displays the operational makeup and the interrelationships of these operations in the forecasting and formation of nuclear power programs and a comprehensive long-range plan of development for those industries included in the nuclear power complex. The close interrelationship between the planning of scientific research and industry is shown by a block for the determination of the needs of industry in the development of equipment and technology and effective directions for the utilization of the new results from scientific research and experimental design work. A positive feature of this long-term planning program is the combination of the processes for forecasting and forming programs and plans for the development of the nuclear power complex into a unified cycle of interrelated operations. The results from forecasting programs and the coordinating of these programs with specialized plans should insure the best continuity.

At the present time, we have good reason to believe that the CEMA member-nations will insure the realization of a comprehensive and specific approach to managing the development of the nuclear power industry up to the year 1990. Within the scope of the previously mentioned long-term specific program of cooperation, we have concluded the Agreement on Multilateral International Specialization and Cooperation in the Production and Mutual Supply of AES Equipment for the Period 1981-1990. We are creating the necessary organizational prerequisites and are solving three of the most important problems in scientific and technical cooperation within the nuclear power industry: the mastery of water-cooled water-modulated reactors with outputs on the order of 1,000 MW; the development of high-output fast reactors; and the development of nuclear heat and power stations and nuclear heat plants.

However, features of the process for the integrated development of a nuclear power complex--a considerable rate of growth, a broad spectrum of scientific research and feasible structural transformations, the time lag and the capital-intensive nature of the problem--dictate that technical and economic studies of the prospects for a CEMA member-nation nuclear power complex be conducted for the years beyond 1990 and that corresponding long-term cycles for managing its development and progress be organized.

Control over the development and progress of the nuclear power complex and the realization of the corresponding industrial-economic and scientific-technical activities are contained in the field of activity of a number of agencies and organizations, primary among which are:

a) at the national level:

- the highest organs (government and joint agencies for planning, finance, technical development, foreign trade, etc.)

- special ministries (ministries of power, metallurgy, machine construction, instrument engineering, construction and the construction industry, etc.)

- the organization of a scientific-research and experimental-design base;

b) at the CEMA level:

- supreme organs (Supreme Soviet, Executive Committee),

-committees for cooperation in the area of planned activity and for scientific and technical cooperation, as well as their working agencies (namely, the Working Group for the Fuel and Power Balance and the Council for Scientific and Technical Cooperation in the Area of Fuel and Power Problems--the TEP Council),

- special Permanent Committees (namely, those for the utilization of nuclear power for peaceful purposes, for electric power, for machine building and for construction) and their working agencies,

- international economic organizations (namely, international economic organizations of Interatomenergo and Interatominstrument),

- international organizations of the scientific research base (namely, MNIIPU--the International Scientific Research Institute for Control Problems).

Within the organizational plan, integrated programmatic-specific planning and management of the CEMA member-nation nuclear power complex according to diagram 2 should be constructed on one interrelated plan of harmonious work coordinated by the above-mentioned agencies and organizations at the national and international levels.

Let us now dwell upon the status of the work being done in the area of forecasting the long-range development of the nuclear power industry in socialist countries. We refer here to the work being carried out within the scope of activity of the Committee of the Scientific and Technical Council which, on behalf of the 24th meeting of the CEMA Session, organizes the development of a scientific and technical forecast for the solution to fuel and power problems in the period to the year 2000 and for the long term. This work, being carried out from 1980 to 1984, is based upon data from interested CEMA member-nations regarding the planned development of national fuel and power complexes.

The first meeting of the Provisional Collective of Scientists and Specialists (VKUS), created by the TEP Council to develop a forecast for the development of the nuclear power industry, took place from 27 to 30 January 1981 in the city of Ostrava in the Czechoslovak Socialist Republic. The meeting examined materials prepared jointly by the Czechoslovak and Soviet sides with the participation of a department of the Secretariat's Scientific and Technical Council and MNIIPU. Two major documents were submitted for approval:

1. a program of development and

2. organizational and methodological statutes regarding the development of a forecast for the growth of the nuclear power industry in CEMA member-nations in the period to the year 2000 and for the long term.

The sixth session of the TEP Council which took place in Berlin, East Germany from 16 through 19 June 1981 approved both documents and noted that the Soviet Union had assumed the duties of the coordinating nation.

This program of development and the organizational-methodological statutes determine the makeup and the interdependence of work being done at the national and CEMA levels. Work at the CEMA level is oriented toward correlating and systematically combining national forecasts and forming the best strategy for the intensive development of the nuclear power complex of CEMA member-nations together with the drawing-up of recommendations for the individual countries. Forecast studies at the national level are oriented toward the formation of an optimum long-term strategy for the country which is based on its specific situation and which insures the participation of national organizations in international cooperation for the realization of integrating measures in the area of nuclear power generation and related areas of the nuclear power complex. Studies carried out at the national level are the chief and initial basis for forecasting. Two major stages have been proposed: the development of a forecast plan and, naturally, the forecast itself. During the first stage, alternative strategies for the development of the power industry itself are examined and evaluated. During the second stage, these strategies are refined and adjusted. In addition, suggestions are developed regarding integrating measures and the contribution of each country toward their realization.

At first, the countries develop a structure for the development of the national nuclear power industry and carry out an initial evaluation of the long-term requirements for external deliveries of the basic types of equipment and scarce resources and the feasibility of making their own deliveries to the other countries. On the basis of these data presented in CEMA, the Provisional Collective of Scientists and Specialists work out alternatives for an interindustry structure and scenarios for the development of the nuclear power complex so as to satisfy the countries' requirements for the development of the national nuclear power industries to the maximum degree possible. As a result, the basic directions for the development of the nuclear power complex are determined. They expand and deepen the sphere of scientific-technical and industrial-economic cooperation among the countries and contribute to the achievement of their national goals.

At the next stage, the structure for the development of the country's nuclear power industry is refined, with consideration being given to the basic directions for the development of the CEMA member-nations' nuclear power complex on the whole. Specific alternatives are being developed for the realization of long-term goals for the growth of the national nuclear power base.

At the same time, on the international level, alternatives are worked out for the realization of integrating measures for CEMA member-nations as well as mutually advantageous alternatives for scientific-technical and industrial-economic cooperation.

At the concluding stage of forecast development, the specific structure is submitted for approval and a plan of the decisions is prepared for examination by the corresponding CEMA agencies with regard to integrating measures which insure the long-term growth of the CEMA member-nation nuclear power complex.

Let us dwell in more detail upon the development of a forecast plan for the growth of the national nuclear power industry. The development of a forecast begins with the determination of the scope of the national nuclear power industry for the years 1990-2000-2010 and the selection of types, unit outputs and the stages of utilization of nuclear reactors. Then studies are developed for determining the basic tasks of scientific research, alternatives for the development of an industrial and construction base and the demand for scarce materials and the basic types of equipment. Simultaneously, as a result of the determination of the structure of AES's, ATETs's and AST's planned for construction in the period to 2010 and the evaluation of the prospects for the utilization of nuclear power installations in metallurgy, chemistry, agriculture, transportation and in other sectors of the economy, we are conducting:

- an analysis of ecological factors and the identification of the corresponding limitations on and requirements for the construction of nuclear power installations;

- the development of alternative methods for maintaining, storing and transporting spent fuel and for processing and burying radioactive wastes;

- the development of alternative methods for decommissioning nuclear power installations.

Naturally, these problems in the development of the nuclear power industry give rise to their own scientific-technical and industrial-economic questions. A study of the alternative methods for developing production and scientific research in individual sectors of the nuclear power complex concludes with a system for evaluating alternative methods for the development of the power industry. If it becomes necessary, the previously selected structure and alternative methods for the utilization of nuclear reactors can be adjusted according to the results of this evaluation in order to improve the effectiveness of the solutions obtained. After satisfactory results are obtained, a selection is made of the major directions for the scientific and industrial work being done to insure the development of the national nuclear power industry. The country then draws up proposals for international cooperation in the given area.

It must be noted that the initial selection of the structure and alternative methods of utilization of nuclear reactors is a most critical stage in the development of a national forecast. This selection essentially determines future scientific and industrial activity both within the scope of the national nuclear power program as well as international programs for the integrated development of the nuclear power complex. Thus, we must develop this stage with particular care, enlisting the aid of leading scientists from various sectors of the nuclear power industry.

In order to carry out systematic research and optimize strategies for the long-term development of the CEMA member-nations' nuclear power complex, MNIIPU together with the interested national organizations is formulating a system of mathematical economic models. This system includes models for the development of fuel-cycle sectors, a model for the development of the power-production base, a model for the development of the machine-construction base and the related nuclear-power production industries as well as a model of the interrelations among sectors of the nuclear power industry. This system of models reflects the multistage process of production (for example, the extraction, enrichment, processing, etc. of ores) and considers the basic production parameters which determine its technological feasibility and its technical and economic efficiency. Moreover, the models directly reflect the results of the development of new equipment and techniques and their introduction into industry.

The realization of tasks regarding research and the optimization of long-term strategies for the development of a nuclear power complex utilizing the indicated models is accomplished on the basis of the SOPOT [expansion not provided] man-machine system developed at the International Scientific Research Institute for Control Problems. This system is problem-oriented toward the solution of tasks involving simulation and the optimization of intersector industrial complexes [3]. The SOPOT system consists of: a data bank; a generator of model programs; a numerical-method library; a model-research and problem-solving block; and an interactive-procedure block.

The features of the SOPOT system provide:

- the capacity for system correlation and problem decomposition in multilevel organizational systems;

- facility in adjusting mathematical economic models and problem conditions;

- the solution to complex data problems, including the answers to nonoperational queries.

At the present time, MNIIPU is organizing the exchange of SOPOT system software with interested national organizations. The planned exchange will enable the countries to reduce considerably the time and resources spent on creating a system for simulating the growth of national fuel-and-power complexes, as well as to prepare a basis for combining national systems of power-industry models in order to conduct joint investigations of alternative strategies for integrated development of fuel-and-power complexes.

In conclusion, we must emphasize:

1. the importance of data formulated at the national level and, thus, the complexity of the makeup of national working groups. It is desirable that all interested agencies and organizations in the scientific-technical and economic spheres of each country participate within the scope of these working groups. The participation of administrative and economic agencies (the State Planning Committee, the ministries, etc.) is necessary in view of the fact that these agencies are the ones which will subsequently utilize the results of the forecast and can from the very outset intro-

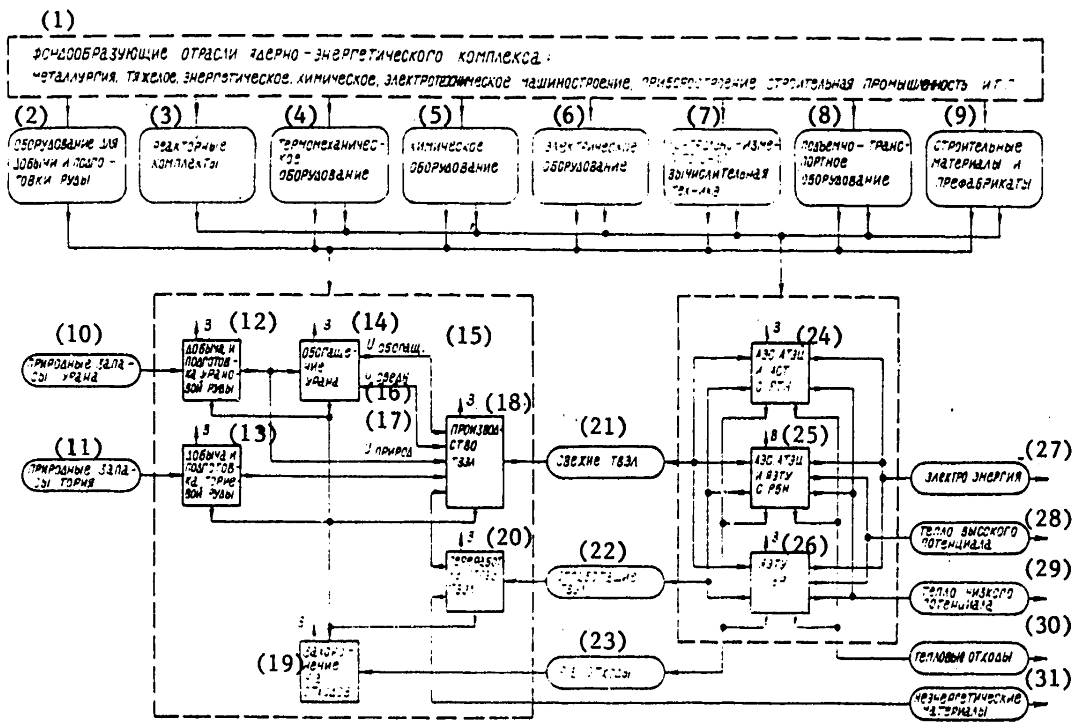

Figure 1. Diagram of Interindustry Structure of the Nuclear Power Complex

Key:

- B. Radioactive discharges and waste
- 1. Revenue-generating sectors of the nuclear power complex: metallurgy, heavy, power, chemical and electrical machine construction, instrument engineering, the construction industry, etc.
- 2. Equipment for extracting and preparing ore
- 3. Reactor units
- 4. Thermonuclear equipment
- 5. Chemical equipment
- 6. Electrical equipment
- 7. Instrumentation and computers
- 8. Hoisting and transporting equipment
- 9. Construction and prefabricated materials
- 10. Natural reserves of uranium
- 11. Natural reserves of thorium
- 12. Extraction and preparation of uranium ore
- 13. Extraction and preparation of thorium ore
- 14. Uranium enrichment
- 15. Enriched uranium
- 16. Depleted uranium

Figure 1. Key (con'd.)
17. Natural uranium
18. Production of fuel elements
19. Burial of radioactive wastes
20. Processing of spent fuel elements
21. Fresh fuel elements
22. Spent fuel elements
23. Radioactive wastes
24. AES's, ATETs's and AST's with thermal reactors
25. AES's, ATETs's and nuclear power installations with fast reactors
26. Nuclear power installations with high-temperature reactors
27. Electric power
28. High-potential heat
29. Low-potential heat
30. Thermal wastes
31. Non-power materials

duce the necessary corrections in the studies being conducted and orient these studies in accordance with their own requirements. The immediate users will be the organizations in the scientific-technical sphere which will introduce the desired scientific approach and methodological apparatus into forecast studies;

2. the important role of meetings of the Provisional Collective of Scientists and Specialists which will observe and evaluate the progress of the work, insure the exchange of information and experience as well as consolidate individual points of view and discuss all data presented by the member-nations and the coordinator;

3. the extraordinarily vital and complex role of the coordinator. In contrast to the Provisional Collective of Scientists and Specialists, which can operate only periodically during the course of its meetings and will be limited to the discussion of the materials presented, the coordinator will continuously carry out the following activities on an international scale:

- prepare proposals for refining methodological instructions and working programs,

- develop a conceptual plan for an integrated nuclear power complex (at the first stage of development),

- evaluate materials presented by the countries regarding national nuclear power complexes and develop plans of the corresponding recommendations,

- evaluate the countries' considerations regarding an integrated nuclear power complex, summarize them and, finally,

- complete editing of the forecast plan and the final forecast for the integrated nuclear power complex.

Naturally, in order to successfully implement such broad and multilateral activity, the coordinator must make extensive use of its own scientific-technical potential and accumulated expertise in the area of organization of forecast work.

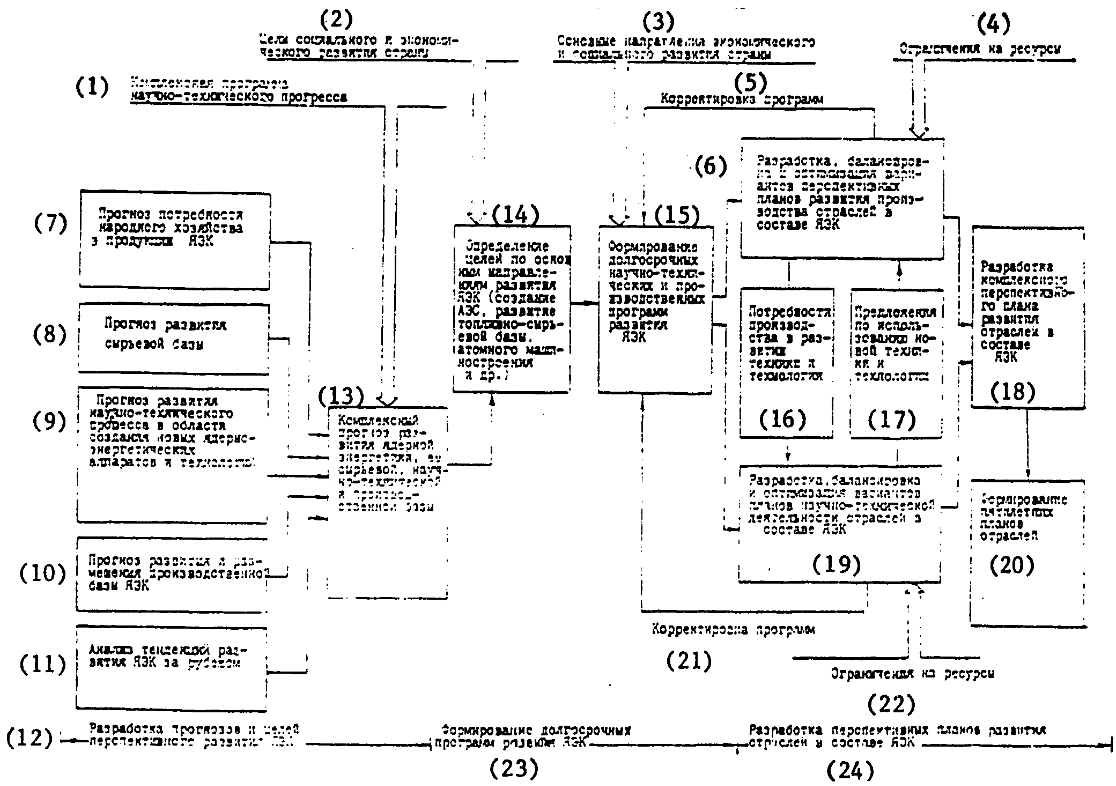

Figure 2. Overall Structure of a System for the Long-Range Developmental Planning of a Nuclear Power Complex

Key:

1. Joint program of scientific and technical progress
2. Goals of the country's social and economic development
3. Basic directions for the country's economic and social development
4. Limitations on resources
5. Program adjustment
6. Formulation, balancing and optimization of alternative long-range plans for the development of industrial production within the nuclear power complex
7. Forecast of economic requirements for the output of the nuclear power complex
8. Forecast for the development of the raw materials base
9. Forecast for the development of scientific and technical progress in the creation of new nuclear power equipment and technology
10. Forecast for the development and situation of the nuclear power complex's production base
11. Analysis of foreign trends in the development of the nuclear power complex
12. Formulation of forecasts and goals in the long-range development of the nuclear power complex

Figure 2. Key (con'd.)

13. Integrated forecast for the development of the nuclear power industry and its raw-material, scientific-technical and industrial base
14. Determination of goals according to the basic directions for the development of the nuclear power complex (the creation of AES's, development of the fuel and raw-material base, nuclear equipment construction, etc.)
15. Formation of long-term scientific-technical and industrial programs for the development of the nuclear power complex
16. Industry requirements for the development of equipment and technology
17. Proposals for the utilization of new equipment and technology
18. Formulation of an integrated long-range plan for development of industries within the nuclear power complex
19. Formulation, balancing and optimization of alternative plans for scientific-technical activity in industries within the nuclear power complex
20. Formulation of five-year plans for industry
21. Program adjustment
22. Limitations on resources
23. Formulation of long-term programs for the development of the nuclear power complex
24. Formulation of long-range plans for the development of industries within the nuclear power complex

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VALUE ADDED, KEYING OF WAGES DISPUTED

Prague POLITICKA EKONOMIE in Czech No 12, 1981 pp 1269-1278

[Article by Milan Matejka]

[Text] A still wide open subject in the socialist economy is the system of [economic] indicators. On pages of various publications, we argue about ways to measure certain economic phenomena (the past few years it was characteristic to discuss measuring of production efficiency), and changes occur even in the economic practice, with considerable differences between the individual socialist countries.

The question of relations between the indicators is actually wide open. The economic units (VHJ and enterprises), for example, are being mandated values for individual indicators without any definitions of their relations. The indicators are not the system, they are only a set of measurements. That together with the differences in indicators has some serious practical implications. The Khozraschet [cost accounting] units are manipulating the production process to fit into the range delimited by the set of indicators; the decision making process in this context is very subjective (the number of variables to be decided upon can often be extensive) not because it is left upon the VHJ or the enterprises but because it is not backed by scientific data. If the indicator relations are not properly formulated then, in most cases, we are unable to determine which of the possible answers is the best (only in a few cases is a given variable best according to all indicators). Only a scientifically defined relation of the indicators, conversion to a higher quality of a set of indicators--in a system of indicators--will create conditions for objective optimalization.

But the management of production within these limits is not quite so coincidental, dependent on the intuition of decision maker as to which indicator to choose in a given situation. Defacto priorities among indicators do develop in the subconsciousness of the managers and gradually become fixated, based primarily on the stake which the collectives and individuals have in the specific indicators. It is only natural, and historically confirmed, that the greatest motivation is provided by indicators which determine the wages and salaries. The interest in such indicators is often so strong that it leads to a lag in the uses of other indicators (for example, a plan for a product mix) and even pushes into the background the khozraschet principles.

Such preferred indicators in the past were the gross production and later performance (an indicator of similar characteristics like the enterprise gross production, but including all activities--even indirect labor) or the indicators of labor productivity derived from it. Currently we are conceived with the value added as the basis of the wage structure.

The total performance in our economic practice is being succeeded by value added in its broader context; in some relative indicators comparing output (production) with input (used production resources), as for example, labor productivity indicators, capital asset effectiveness, or indicators of production cost efficiency.

The actual function of gross production or performance as a criterion indicator was undisputably bad. The main reason--the possibility of its maximization by uneconomical processes, primarily uneconomical vertical cooperation--has already been theoretically clarified in the fifties and it is only surprising how long this indicator (in its variations) survived in this function. Of course, we must also be able to see its objective function in the system of value indicators and not to dismiss it out of hand.

The value added must then be approached similarly. An indicator of this type is indisputably a significant signpost. It is one of the traditional western statistical indicators (value added in manufacturing). But its worth should not be overrated. In this article I wish to point out primarily:

a) the general irreplaceability of gross production (performance) by value added;

b) the questionable value of regulating wages according to any value indicator including value added.

Total Performance and Reduced Production Indicators Relative to Inputs

If we evaluate the demands of the manufacturing process on production resources, whether from the point of view of cost or its dependence on the resources, we must always compare these resources (inputs) with the total performance (outputs). The replacement of the total performance by a deflated output is not appropriate within this context; derived relative characteristics are subject to a very questionable interpretation and utility.

If we strip the material costs or even just part of them from the value of the newly created product, it means the reduction [deflation] of the output by the value of a portion (possible of all)used up production assets. The value of relative indicators always reacts to the consumption of that portion of production assets by which the value of the created product is also reduced, further also to consumption or dependence of the production factors expressed in the second item of the relative indicator. Thus for example, the proportion of wage costs to the value of net production, $\frac{v}{Q-c}$, reflects how labor-intensive the product (Q) is, (when capital consumption goes down and the numerator (v) drops and thus the value of the relative indicators will also decline. At the same time the product becomes less capital intensive (when the materials costs (c) fall, the denominator increases and the value of the relative indicator falls again).

The situation is further complicated by the varied reaction of these relative indicators to the changes in individual cost items. Because with the changes in material costs (as such) or at least in a partial change, the value of the deflated production indicators also changes, while with the change in the wage costs (as such) there is no change[1] then, according to the derived relative indicators, the unit change in wage costs (for example, a change by Kcs 1.00) is not equivalent to the unit change in material costs. This, of course, results in a highly questionable use and synthesis of these relative indicators.

We are illustrating the net product cost on an example of indicators.[2]

Let us assume the possibility of manufacturing a certain product with a value of 100 monetary units using three different technologies under conditions described in the table. Our task is to estimate the overall costs of production. production.

Manufacture Using Technology	Material Costs (c)	Wage Costs (v)	Total Costs (c+v)	Total Value of Manufactured Product (c+v+m)	Net Product Value (v+m)
1	40	40	80	100	60
2	50	32	82	100	50
3	50	25	75	100	50

1. When for wage costs of the product, for example, fall and all else (price, material costs) remain the same, the profit increase is equivalent to the drop in wage costs and the net production value does not change.

2. We have selected net production for its simplicity. We could come to the same conclusions if we used value added instead.

If we use for the evaluation of the total costs the proportion of wage costs to net production (wage costs are in the numerator, material costs reduce the value of the manufactured product in the denominator), then the technological process 2 appears to be more advantageous than process 1, because:

$$\frac{v_2}{(c_2+v_2+m_2) - c_2} = \frac{v_2}{v_2 + m_2} = \frac{32}{50} = 0.64, \text{ while}$$

$$\frac{v_1}{(c_1+v_1+m_1) - c_1} = \frac{v_1}{v_1 + m_1} = \frac{40}{60} = 0.67$$

But in reality, the costs for the same product are higher with the use of process number 2.

The evaluation of overall costs will not be objective even if we assume that (in an obvious contradiction to reality) the ratio of wage costs to net production is only an indicator of relative use of labor and the relative use of production assets is expressed as a ratio of material costs to net production. Total production costs will then be defined by the ratio of total costs to net production.

This is obvious from the evaluation of alternatives 1 and 3 from our example. Using the ratio $\frac{c + v}{v + m}$, we find the technological process 1 more profitable because

$$\frac{c + v}{v + m} = \frac{80}{60} = 1.33 \qquad \frac{c + v}{v + m} = \frac{75}{50} = 1.5$$

even though the total costs for the same product are lower with process 3.

The synthesis of material and wage cost levels of net production is also questionable from the formal logical standpoint. Both indicators are qualitatively different types of structural measures. While the ratio of wage costs to net production is the indicator of the structure of net production (a proportion of the total), the ratio of material costs to net production as an indicator characterizes (in another way) the structure of the entire product. (This is a different type of structural indicator than the proportion of the total.) Thus we cannot justify the adding up of material and wage cost net production indicators even by a formal logic.

Also questionable is, of course, the ability to separate and utilize not only the cost indicators but also indicators of linkage of net production (value added, etc.) to resource allocation. These indicators react not only to the linkage of a given item of production resources during the manufacture of the product, but also to the wear of that portion of production asset which we use to deflate the value of the created product. We would be hard pressed to find logical arguments for an appropriate combination of production requirements to wear and [resource?] allocation.

And, if the ability to separate these indicators is questionable, that much more doubtful is the formulation of their internal relations. If we further consider that the deflation of production [indicators?] can differ, it is obvious, that the relative requirement indicators of net [deflated?] production on the use and allocation of production resources cannot be used as the basic elements of the system of relative indicators of relations between inputs and outputs.

Value Added and Wages

The basic problems of the wage amount relation to value added derives from the elements of the value added is composed.

It is undeniable that the increase in transferred value (depreciation and possible supplemental materials and energy*) included in the value added (item c_a) does not by itself, create conditions for wage increases. Even if this portion of the cost of production material correlates closer with the quantity and quality of the actual direct labor than the remaining portion of material costs (C_b), including primarily the value of the used basic material, we cannot expect a consistent relation. Thus, for example, the increase in depreciation can, in most cases only be related to the growth in direct labor involved, yet the rate of increase of either factor will be generally different, we might have to admit the possibility of an opposite development of both indicators--increase in depreciation with a decrease in actual direct labor. We will show, that the problems arise primarily in the substitution of direct labor for capital.

We can come to analogous conclusions concerning profits. In production pricing we must assume that the profitability depends on the amount of production assets tied up in the corresponding production run; a change in the labor structure--substitution of direct labor for past labor input, or an increase in the value of the past labor content without changing the amount of direct labor--creates a formal condition for the increase in the level of wages (it increases the value of profit per unit of direct labor) and that means even if economic conditions for this increase have not been created, that profits per unit of total labor are falling.

Concerning the third element of total performance, the wage costs, the relation between the wages and value added appears at first glance to be the most questionable. It almost appears to be a case of tautology--we are keying wages to wages. Actually, it is not quite so because we do not consider the alue added to be a sum of individual items, i.e. $V=c_a + v + m$, but as a differentiation subtracting the value of cost of material from the total performance, i.e., $V = Q - c_b$.

* Limits of the reduced indicators are often different

Thus value added is determined by the factors Q and c_b; the relation of wages to value added then determines the size of the factor "v" of value added and, indirectly, the value of profits; wage increases within the framework of a given value added will lead to a fall in profit and vise versa (factor c is not affectdd by the wage levels.

For further clarification, let us use numerical examples. Monetary indicators are expressed in thousands of Kcs.

Period	Value of production Q	Number of employees T	Capital asset original purchase price P	Material element of value added c_a	Other material costs c_b	Value added V
Base	200	50	200	30	50	150
Current	220	35	300	45	68	152

We can explain the value of the indicators in that during the current period there was a qualitative improvement in capital assets as compared to the base period. Instead of mechanized, qualified-labor intensive production we have switched to automated production with a reduced number of workers. The need for employee qualifications and work intensity has not changed (operating automated machines does not require higher level of qualification than mechanized production, often the opposite is true).

Has we, under the conditions stated above, tied the wages to the value added, then we would have in the current period (compared to the base period),

--a slight increase in total wages;

--a rapid increase in the average wages.

However, neither is economically acceptable. On the face of it, the situation is satisfactory,

--a reduction in total wages, and

--a stagnation in the average wage (quality and intensity of direct labor has not changed).

Wage as a Necessary Product

The question then remains: Which indicator should determine the wages if we reject not only performance but also value added?

It is my opinion that we cannot justify keying the basic wages to any general value indicator (above we have indicated reasons why we could not use profitability and in this relation, we can easily justify the unsuitability of net production). The fact is that we cannot view the basic wages as an element of distribution of a manufactured product; it must be understood primarily as a cost element, as a necessary product with its size corresponding to the amount and quality of direct labor in the given production run; the wages (together with other social costs) are to ensure the replacement of labor which has been used up by the production process.

This understanding of the (basic) wage is roughly correspondent to the contemporary economic practice. This is most obvious in the case of piece-work labor where the wages bear the closest relation to the quality and quantity of the specific accomplished work. In case of the administrative and supervisory personnel we are trying, within our possibilities, to reflect the accomplished work by classifying them in wage categories corresponding to the work requirements based on required qualifications, physical difficulties, work conditions (difficult environment), etc., again, in such a way that we ensure the replacement of labor. The labor replacement must also be ensured under unfavorable developments in any of the general value indicators; the concept of necessary product, introduced by the Marxist political economy, does have its full justification.

It follows then: The principal approach to the objective remuneration should be through higher quality work norms for piece-work labor and better quality job classification system for other employees and, naturally, the criteria for their assignments into a specific wage grade.

This route is no doubt considerably more difficult than tying the wages to a given value indicator. Ensuring comparability of inter-enterprise norms and inter-professional wage-rate comparability are theoretically and practically an extraordinarily difficult task. But, according to my opinion, there is no other way to judge objectively the work effort and the corresponding basic wage rates.

Other Wage Functions

The reader is certain to object: "The view of wages as a necessary product is very lopsided. In determining the level of wages, especially under socialism, we cannot subtract from the value of commodity production; it is primarily necessary to ensure that there is a correlation between consumer goods and the public purchasing power. The wage must be a factor dependent on distribution of commodity production.

Keying the wages to value indicators, furthermore, has a motivating function--it causes the workers to develop a stake in the value of commodity production and stimulates growth of production through the increase in labor productivity.

A position on the objection: Ensuring a balance between the consumer goods and the public purchasing power is without a doubt a serious problem. However, we cannot achieve such balance by tying the wages to gross production, because it absolutely cannot be justified due to the nature of gross production. The past experience, when total demand constantly exceeded supply, has also convinced us of this; after years, when the wages "slipped" excessively, centralized measures to slow the wage increases had to be implemented, regardless of the gross production developments.

At the macrolevel we can justify maintaining a relation between the wages and net production (approximately also value added). However, the problem lies in the fact that keying wages to net production is not appropriate for ensuring this relation at the microlevels. The macro-micro relations are complicated and agreed to. The reasons why we cannot generally ties the wages to net production have been noted and illustrated above.

Furthermore: Relation between the level of output and wages can also be derived from wages conceptualized as a necessary product. From wage costs we derive material costs and from total costs (indirectly) also the cost of production. Even this process, of course, has its danger points, but it is not wholly unrealistic. It is actually being practiced in capitalist countries where, in spite of the negative points of the system, the problem of demand exceeding supply does not arise. The traditional wage regulations by the way of general value indicators then is not the only way* and it certainly would be worthwhile to investigate other methods, more so, because that traditional method did not prove very successful in practice and we can easily point out its weaknesses.

The problem of individual incentives in the production is also more complicated than it would seem at first glance.

First of all, it is debatable whether maximization of the production indicators even should be the employees primary interest--independently of how they are defined (the gross production, valued added, net production, etc.) and whether it would not be better to aim the main incentive elements at the effect (profit) and efficiency (i.e., return on investment).

Second, individual stake in the economic results does not have to be ensured by keying the basic wage rate to the corresponding economic result indicator. For that we can use supplemental (bonus type) wage components--just as it is in the current CS [Czechoslovak] practice when approximately 20 percent of the total remuneration is dependent on the return on investment.

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* The wage developments in Hungary are today weighed on the basis of natural production indicators (the weights in the heterogenous production are wages and depreciation of the base period), which tie the wages much better in with the expanded direct labor, than coupling of wages to level of output indicators. (More of the effects of changes in the production structure are eliminated.)

The existing combined wage relation to two value indicators is, in its way, a double bonus where the value added carries a greater weight which is a defacto priority given to this indicator and might result in a selection of not the most effective solution. (That also applies in the case where we will be deciding in the interest of maximum wages, considering the size of its base and supplemental elements, that is, when we will take into consideration both indicators to which the total wage is tied.) From the preceding discussion it follows that the principle of the combined designation of the total wage could be established on a very rational basis, as long as the basic element is understood to be a "necessary product"; the supplemental element than is the item of distribution of the economic results and dependent on its size (of the profit).

Third: The concept of wages as a necessary product generates an interest in the efficient growth of production. It is quite obvious in the case of the piece-work employee (the more they produce, the higher their wages) and indirectly (through higher qualification [requirements]) this goal can also be achieved for other employees.

Wages and Labor Productivity

The innate cause of the problems arising in keying the wages to general value indicators can be seen in measuring of labor productivity. This interaction has historically developed from the relation of the wage levels to labor productivity in the interests giving priority to the requirement that the productivity grow faster than the average wages.

If we express labor productivity as a relation

$$v = \frac{Q}{T},$$

where Q is production indicator

T is manpower indicator,

average wage as a ratio $m = \frac{M}{T}$

where M is the amount of total wages

and if we require that $I_v > I_m$, that is $\frac{v_1}{v_o} = \frac{Q_1}{T_1} : \frac{Q_o}{T_o} > \frac{M_1}{T_1} : \frac{M_o}{T_0} = \frac{m_1}{m_o}$,

than the relation $\frac{Q_1}{Q_o} > \frac{M_1}{M_o}$ applies.

The requirements of growth in productivity faster than growth in average wages then may be reduced to the requirement of production having to grow faster than total wages.

In determining the authorized total wages in the past (adjusted wage fund) we have based both relations (which, of course, with the use of given adjusting coefficients expressing the authorized percentage of growth in total wages for each 1 percent of increase in productivity or production resulted in differing values of the adjusted fund); gradually we switched to another, simpler procedure--keying the total wages to production indicators.

Both procedures assume that the measuring of labor productivity by the ratio of $\frac{Q}{T}$ is correct, that is we used the ratio of some monetary value indicator of production (whether gross, net or only partially reduced by the material costs) to the number of employees (or days or hours worked, etc.). Such is the statistical practice (and economic practice) but it is this practice which has been criticized a number of times. Particularly well known is the basic criticism of a Soviet academician Strumilin.

Production as a Marxist concept is the relation of the amount of production to the amount of labor involved, i.e., past and direct labor inputs and only on this basis can we economically justify the relation of wages and productivity in the corresponding economic unit.

Unfortunately, we must note that the quantification problem of productivity as defined by the Marxist political economy have resisted satisfactory solution on the part of the statisticians, although a number of such experts in the socialist countries have attempted it. The problem lies in quantifying the amount of production in cases of heterogenous products (monetary value indicators, even if at deflated prices are not, strictly speaking, volume indicators) and thus (primarily) in quantification of total labor input. As for direct labor, we cannot objectively measure its intensity and quality (according to Marx, in a more intensive work we are expending more work per time unit while skilled work is really a multiplied simple work) and we are in fact only measuring the production time. As far as past labor input (dead labor) is concerned, it is not quite clear what use (whether dependency on or the consumption of production means--because neither is an analogy to expended direct labor). Additionally, we have the problem of synthesis of the two elements as a result of various measuring units of direct and past labor inputs.

Symbolically speaking, instead of the relation

$$v = \frac{Q}{L_a + L_b} = \frac{Q}{T.k.i + L_b}$$

where v is labor productivity

- Q - production
- L_a - direct labor input
- L_b - past labor input
- T - time worked (average number of workers in the period or number of days or hours worked)
- k - quality of labor input (labor skill)
- i - labor intensity

we find in practice only the ratio

$$v' = \frac{Q}{T}$$

We can justify the measuring practice by the complications in measuring the labor productivity; however, we should be aware of the simplifications made and infer any consequences.

One of these consequences is the inappropriateness of wage relations to the simplified productivity characteristics at the micro-levels. A complete disregard of past labor input in the denominator will result in a substitution of direct labor for past labor input, in an increase in the indicator value without a corresponding actual productivity increase (Marxist concept of productivity). We cannot subtract from past labor input because even this labor input into the production of the evaluated production unit was in the past, and in another production unit, the direct labor.

We take past labor input into consideration in the productivity indicators which use the net production in the numerator; here we reduce the value of the created product by the cost of material. But even this solution is not in concert with the basic conceptual definition of productivity. Even if we made the past labor input identical to the secondary inputs, we cannot interchange the ratio of the two factors with the ratio of the same two factors reduced by the same amount. If we express the productivity of total labor in general terms by the ratio $\frac{Q}{L_a + L_b}$, and the indication constructed as the ratio of net production to direct labor input, $\frac{Q - L_b}{L_a}$ then we cannot call it a productivity indicator. The cancelling effect of the two ratios as well as their development are different. The first may be increasing and the second may be increasing and falling at the same time.

Period	Q	L_a	L_b	$\frac{Q}{L_a + L_b}$	$\frac{Q - L_b}{L_a}$
base	200	50	100	1.33	2.00
current	200	48	103	1.32	2.02

If we cannot unconditionally accept the dependence of the average wages on any of the currently employed labor productivity indicators, we cannot accept the dependence of the volume of wages to production indicators either. Much less can we then accept a dependence on other general absolute indicators (i.e., profit, production costs, etc.) because their characteristics do not define labor productivity (they do not appear in the numerators and by reducing the denominator we will not arrive to the appropriate linkage either).

CSO: 2400/196

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