PROBLEMS OF INTERREFINERY COMPARATIVE ANALYSIS OF PRODUCTION ECONOMIC ACTIVITIES

V. M. Kirpichev

Interplant comparative analysis is one of the most effective directions in economic analysis. Whereas interplant analysis is limited primarily to study of experience and comparison of indices for a single manufacturing plant (comparison with a preceding accounting period, with the Plan indices, or with the plant's own standards), in interplant analysis the comparisons are made among several plants, or even among all the plants in the particular branch of industry.

The main purpose of interplant (interrefinery) analysis is the uncovering of reserves of production in the plants being compared, the determination of the reasons for differences in efficiency of operation of the individual plants, and the use of this information to reveal the optimal technical and organizational solutions. Hence the results of interplant analysis should be used first of all in the Plan of organizational/technical measures, with the aim of the fastest possible introduction of these measures into production. For example, interplant analysis of the reasons for differing utilization of material, labor, and financial resources shows the way for application of the progressive operating experience of the best of the compared plants to all the other plants of the Branch. Also, interplant analysis can provide a more objective evaluation of how well all the production resources of a given plant are being utilized; i.e., the actual results of the activity of the workers' collective in the plant can be defined on the basis of comparisons with other plants. Such an evaluation can be used in establishing more soundly based and more demanding Plan assignments for the plant, in resolving the problem of material stimulation [of workers' efforts], and in summing up the results of socialist competition.

Improvements in the production economic activities of plants (refineries) depend on uncovering and realizing production reserves through improvements in the organizational and technical level of production, improvements in the utilization of fixed assets and working capital, improvements in the productivity of labor, reductions of manufacturing cost, and increases in the level of profit and profitability of the production facilities. As is well known, all sides of the production economic activity of a plant are characterized by a system of natural-unit and cost-unit indices [1]. However, the overall indices for plants of entire branches of industry are the most general indices such as turnover ratio, labor productivity, and profitability of the production facilities. In this connection, we are setting forth in this article a methodological approach to interplant comparative analysis of refinery operation in the example of these three indices.

The basis methodological problem in interplant analysis is in determining the feasibility and means for comparing operating indices of refineries that differ in overall process flow plan, in depth of processing the crude oil, in quality of the crude being processed (and hence in quality of the products), in capacity, in level of sophistication of equipment and technology, in level of combination, specialization, and coordination of production, etc. All these objective conditions, not just the degree of utilization of production resources of the refinery, determine to a considerable degree the technoeconomic indices of the basis of the absolute levels of the indices, and it is even more ridiculous to take the best indices achieved by one refinery as standards for all refineries of the Branch without regard for their specific operating conditions.

The limited possibilities for comparison of operating indices of different plants have been pointed out in the economics literature. In this connection, in order to reduce the degree of noncomparability of the plants included in an analysis, it is proposed in [2] that interplant comparisons of the utilization of production facilities should be made only among plants that are similar in product mix and process technology. However, it

TsNIOékonomiki, VNIPIneft' [Central Scientific-Research Economics Branch, All-Union Scientific-Research and Design Institute of the Petroleum Industry]. Translated from Khimiya i Tekhnologiya Topliv i Masel, No. 1, pp. 40-43, January, 1977.

is hard to agree with such a limitation, as it is specifically the difference in manufacturing processes, when the product mix is identical or very similar, that may be the source of differences in efficiency of utilization of production facilities.

A number of economists consider, in general, that "interplant comparisons of complex indices characterizing the operation of the plant as a whole are not advisable from the standpoint of revealing internal production reserves.... It is far more useful and effective to compare and analyze the production of identical products. . ." [3]. While not belittling the importance of analyzing individual units or production complexes (sections) of the plants being compared, we should still note the inconclusiveness and the restricted nature of such analysis, as it eliminates the possibility of rating the quality of operation of the plant as a whole during the preceding period and of uncovering reserves for possible improvement of the technoeconomic indices of the plant.

It is also noted in [3] that "the necessary conditions for conducting interplant comparative analysis are the manufacture of identical products and basically similar production flow plans"; further, "factors limiting the degree of comparability are the production capacity, level of coordination, and number of existing technological limits on the structure of production," as well as "conditions of geographic location relative to economic district of the country, Plan underloading of capacity, etc." The enumerated conditions of comparability cannot serve as limitations for the interplant comparative analysis of refinery operation.

Another widely held opinion in practice is that the possibilities for interplant comparisons are limited because of the specific conditions of each manufacturing plant. Here we sometimes see a tendency to forego interplant analysis in which certain plants might be placed in an unfavorable position according to the economic results under comparison.

Consequently, the necessary condition for valid analysis of refinery operating indices is comparability of the refineries. In the interest of satisfying this condition, it has been proposed in the scientific literature [4] and in research studies that plants should be grouped on the basis of primary indices of comparability. Since the main condition of comparability is similarity in the product output, which in petroleum refining depends mainly on the processing scheme (fuel, fuel/lube, or petrochemical) and the crude oil quality, refineries are grouped in terms of these attributes and also in terms of the depth of crude oil processing and the capacity.

In order to ensure greater comparability of indices among the refineries being compared, it is recommended that the commercial (gross) production should be arbitrarily reduced to a comparable form by eliminating such objective factors as nonidentical volumes of crude oil run and intermediates brought in from outside, taking into account here the volume of material produced in the refinery and consumed for its own needs (for example, catalysts, additives, paraffins for the production of synthetic fatty acids) [5].

The fixed assets, number of personnel, and other indices for the plants in the comparison can likewise be reduced to comparable form, to one degree or another. For example, if not all of the plants in the comparison have a captive thermal electric power station producing electric energy and steam for internal use, the indices for the power station should arbitrarily be eliminated from the corresponding indices for the refinery as a whole.

Depending on the goal of the analysis, it is recommended in the interest of improving the comparability of indices that individual main production sections of the refineries should be analyzed, i.e., fuel, lube oil, and petrochemical, thus eliminating the influence of levels of capital intensity, labor intensity, and profitability of other production operations. However, individual production sections (blocks) will as a rule differ among themselves in the assortment and capacity of process units, in the quality of feedstocks processed, and hence in the product mix. Therefore, it is not possible to eliminate completely the influence of the numerous objective factors determining the levels of turnover ratio, labor productivity, and profitability of individual production operations.

However, none of the methods under consideration (grouping, elimination, detailing, etc.) provides the required increase in level of comparability of the indices of existing refineries,* since it is difficult to find

*However, some of these methods (e.g., elimination) can be applied successfully in solving such economic problems as establishing a basis for the effectiveness of different processing schemes, refinery capacities, level of coordination, etc. In this case the refineries must differ only by a single factor; the influence of other factors for all the refineries in the comparison must be eliminated.

even two refineries that are essentially identical. If we were to accept the idea of comparing only absolutely identical refineries, we would sharply limit the possibilities of using interrefinery analysis of the plant operations, so that the use of such comparisons would become largely meaningless from the standpoint of national economic interests, as the magnitude of the savings to be achieved through comparative analyses will depend on the quantity and breadth of the comparisons. But most important is this: In comparing indices that have been reduced to an arbitrary comparable form, it is still impossible to answer the question of which of the plants in the comparison are best utilizing the production facilities or what reserves of production are available here, since the absolute levels of the indices in themselves still cannot reflect the true situation regarding the utilization of the production facilities, raw materials, and labor efforts, As already noted, a high absolute level of the indices may be caused by factors unrelated to the productive activity of the plant. For example, the turnover ratio (gross production per unit of capital investment) for one plant may be 1.6 rubles and in another 1.5 rubles per ruble of fixed assets. On the basis of these indices alone, it would be erroneous to say that in the first plant the fixed assets are being utilized better than in the second. In this connection, it is of great importance to find the conditions and comparison indices for plants manufacturing not identical products, but similar or even different types of products.

In our opinion, if an objective rating is to be found for the utilization of refinery production facilities, it will be necessary to analyze the production reserves and to determine the degree of possible increase in turnover ratio, labor productivity, and profitability of the production facilities.

The degree of possible increase in these indices is determined from the formula

$$K_{res} = \frac{\Delta \Pi^{p}}{\Pi^{p}} \cdot 100,$$

where

$$\Pi^{p} = \Pi^{p} + \sum_{i=1}^{n} \Delta \Pi_{i}^{p},$$

K_{res} is the degree of possible increase of the index during the year under study, %: $\Delta \Pi^{p}$ and $\Delta \Pi_{i}^{p}$ are the respective possible increases in the index due to all factors and to the i-th factor, in cost units; Π^{p} and Π^{a} are, respectively, the maximum possible and actual indices during the year under study, in cost units; i is the identifying order number of the reserve factor; n is the number of reserve factors.

When this approach to interrefinery analysis is used, full comparability of the comparison indices is guaranteed for all plants, since the numerator in the proposed formula is the maximum possible increase in the index, calculated for those same specific individual conditions of plant operation as those applying to the denominator, the maximum possible index.

The possible reserves for gains in turnover ratio, labor productivity, and profitability of production facilities can be achieved through better extensive and intensive utilization of equipment, through bringing new units up to full operating capacity within the time required by the standards, through increases in the efficiency of feedstock utilization, through increases in the yields of desired petroleum products and improvements in product quality, through curtailment of crude oil and product losses and fuel consumption, through rational compounding of commercial product components, through curtailment of the time required for fabrication and erection of process units, through reductions in the funds tied up in fixed assets by selling surplus equipment, and through other reserve factors.

Methods for determining changes in the volume of commercial production, profit, value of fixed assets, turnover ratio, and profitability of plant facilities in relation to all the reserve factors just enumerated have been set forth in detail in a thematic review by TsNIIT Éneftekhin [6].

The maximum possible volume of commercial production and profit must be determined on the basis of the optimal variant of refinery operation, with progressive indices of daily capacity, yield of desired products, standard utilization factor for unit operating time, etc.

Let us continue with the analysis of the arbitrary example. We will assume that the reserves of possible increase in turnover ratio (ratio of gross annual production to value of fixed assets) amount to 0.2 rubles/ruble in the first refinery, in comparison with 0.1 ruble/ruble in the second refinery. In this case, the degree of possible increase in turnover ratio in the first refinery will be $(0.2/1.8) \times 100$ or 11.1%, and in the second only $(0.1/1.6) \times 100 = 6.2\%$.

Thus, the percentage of possible increase in the indices being analyzed should also serve as an index for objective evaluation of the utilization of production facilities and materials.

In this approach to interplant analysis of refinery operation, all the refineries in the comparison are placed in equal, comparable conditions, since the reserves of possible increase in the indices under consideration for each refinery are compared with the corresponding maximum possible indices, and these maximum possible indices reflect all the enumerated conditions of refinery operation, including the product mix and quality of crude oil being processed.

In this connection, for a valid calculation of reserves for growth in production, special attention should be given to methodological problems involved in calculating the production capacities of process units. For example, in analyzing the input data used in such a calculation, particular attention should be given to commonality of procedures used in determining the capacities in the refineries being compared, in order that all refineries may be examined under equal conditions. Subsections should be established for this purpose in the scientific-research institutes of the Branch, in order to develop, on a centralized basis, certain All-Branch progressive standards for daily capacity, utilization factors for process units, yields of desired products, and other indices, due regard being given to the experience of the leaders in the field and the specific operating conditions of the individual refineries.

This approach to interrefinery comparative analysis of operations can uncover production reserves and can provide an objective evaluation of how well these reserves are being utilized, through interrefinery comparisons that are independent of capacity, quality of the crude oil being processed, and other objective factors.

The procedures we have set forth here for interrefinery analysis may be applicable to all correlation indices of refinery operation, and also to other branches of industry in which raw materials are subjected to complex processing. It should be noted that these procedures have gone through approval tests, with favorable results in assessing the level of utilization of fixed assets in manufacturing plants of the petroleum refining and petrochemical industry [7].

LITERATURE CITED

1. Procedural Instructions for the Development of State Plans for the Growth of the USSR National Economy [in Russian], Ékonomika, Moscow (1974), pp. 33-37.
2. E. A. Ivanov, Utilization of Production Facilities in Industry [in Russian], Ékonomizdat, Moscow (1962), p. 108.
3. Yu. I. Semin, A. D. Sorokin, and G. P. Koreshkov, Procedures for Interplant Technoeconomic Analysis of Petrochemical Production [in Russian], Khimiya, Moscow (1968), pp. 24-25.
4. V. I. Ganshtak and B. I. Maidanchik, Interplant Economic Analysis [in Russian], Ékonomika, Moscow (1964), pp. 39-40.
5. F. E. Matyushenko, Candidate's Dissertation, MINKh i GP im. Gubkina, Moscow (1967).
6. V. M. Kirpichev, L. L. Savranskaya, et al., Analysis of Utilization of Fixed Assets in Plants of the Petroleum Refining Industry [in Russian], TsNIITÉneftekhim (1975), pp. 49-60.
7. L. L. Savranskaya, Ékon. Organiz. Uprav. Neftepererab. Neftekhim. Prom. (TsNIITÉneftekhim, Moscow), No. 6, 6-8 (1976).