Workers at the VNITI and Taganrog Metallurgical Plant have determined the feasibility of reducing tolerances by an average of 10-30% on elements of 450-1400-mm-diameter wheels (report prepared by Yu. E. Kovalenko, V. I. Kheifets, G. A. Gorovenko, V. P. Skurenko, A. I. Urinson, Yu. V. Yakubovich, and V. K. Lyashenko).

At the concluding plenary session, participants noted the timeliness of nearly all of the reports and the great value of the researches of investigators at scientific research and planning institutes and metallurgical and machine construction plants to the national economy.

One shortcoming of the seminar was the insufficiently broad representation of machine construction plants and, especially, pipe plants. There were no representatives of plants producing automobiles, refrigerators, or agricultural machinery. More active participation by the consumers of rolled products would have made it possible to more accurately assess ways of further improving the quality of rolled products.

EFFECTIVENESS OF PLANS FOR SHOPS PRODUCING COLD-DEFORMED TUBES

V. Ya. Dubrovskii and L. S. Lyakhovetskii

To effect scientific—technical progress, it is necessary that plans which are developed for the construction of capital facilities take account of and utilize the state of the art here and abroad. This is particularly important for rapidly growing areas of industry, since many scientific and technical innovations may appear within the time the project is conceived, executed (built or rebuilt), and made a success. The manufacture of cold-deformed tubing is one such area of industry. However, domestic experience has shown that a long period of time elapses from the initiation of planning to actual start-up of a facility and mastery of the design capacities of the equipment. Naturally, the shop can represent the state of the art at start-up only if scientific and technical advances made during the planning and construction stages are taken into account.

Analysis shows that to take advantage of the latest scientific and technical findings, it is first of all necessary that planning procedures be improved (Fig. 1) and that additional links be forged between planning and science (Fig. 2). The scientific—technical program is central to successfully taking advantage of the most recent advances, as is adequate time and the availability of the needed material-technical resources during planning and construction.

The sophistication of the scientific—technical program may be determined by comparing the facility planned for construction or reconstruction with existing or other planned facilities. However, such a comparison requires, first of all, that the program already be developed and, second, that a suitable analog (standard of comparison) be selected. Considerable time and material resources are required to solve the first problem, while selecting an appropriate analog is often impossible due to differences in the product mix and outputs of different shops making cold-deformed tubing.

These difficulties can be overcome by developing a "theoretical" analog on the basis of statistical analysis of a group of existing and planned shops of one type. Based on a statistical analysis of 16 shops for the production of cold-deformed tubes of carbon and low-alloy steels, we developed a model which makes it possible to determine the adjusted costs for shops of this type in relation to output in thousands of meters of finished tubing and the mean weight of one meter of finished tubing and semifinished product, i.e., in relation to the data found in the scientific—technical program:

$$C_{ad} = 1.31C_m + 775.1q_t + 0.13Q_m - 1{,}299{,}000 \text{ rubles}, \qquad (1)$$

where q_t is the mean weight of 1 m of tubing, kg: Q_m, output, 10^3 m; C_m, cost of the metal of all of the tubing produced (the output), 10^3 rubles, and is equal to $C_m = Q_t F_m \alpha$ rubles, where Q_t is the output of tubing in tons; F_m, cost of 1 ton of tubing, rubles; α, metal consumption coefficient.

Translated from Metallurg, No. 11, pp. 37-38, November, 1980.

 0026-0894/80/1112-0414$07.50

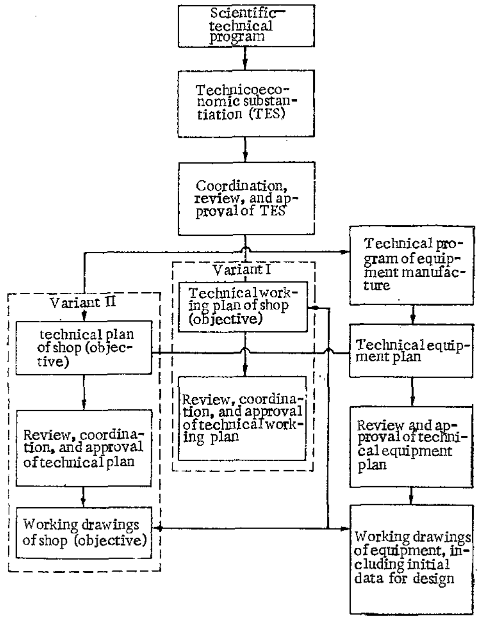

Fig. 1. Existing planning procedures.

The output in tons can be expressed as the output in thousands of meters and the weight of 1 m of tubing, i.e., $Q_t = Q_m q_t$, tons. The cost of 1 ton of semifinished product for cold-deformed tubes depends on the weight of 1 m of semifinished product. Based on this, we found a relation which agrees well with the actual data:

$$F_m = 142.84 + 250.86 : q_s \text{ rubles},$$

where q_s is the average weight of 1 m of semifinished product, kg. Similar statistical models may be constructed for shops of different types, but the models should be refined as new data become available.

The adjusted costs obtained with Eq. (1) are a theoretical analog which can be used for comparison with the projected costs under the given scientific–technical program. If the latter costs are greater than the adjusted costs found from Eq. (1), this means that the program represents a sound investment relative to the equipment that can be purchased at the level of the adjusted costs, and that work on the program should continue. If the projected costs are lower than the adjusted costs, the program is not ambitious enough and should be revised.

Ideally, improvements should continue to be made during planning to take account of current scientific and technical advances. However, in view of time and monetary restraints, the planner must in reality choose those improvements that will yield the greatest relative benefit. This selection may be made using a relation describing the dependence of a basic index of efficiency — adjusted costs — on technical production factors:

$$\begin{gathered} C_{ad} = \sum_{i=1}^{R} C_{ad\,i} = C_{ad\,R}\beta\omega, \\ C_{ad} = l\left\{\frac{q}{1000}[C_s\alpha_R - C_{wst}(\alpha_R - 1)] + \alpha_R\sum_{i=1}^{N}\frac{Bi}{Pi} + E_n\sum_{i=1}^{N}\frac{Ki}{TiPi}\right\}\beta\omega, \\ \beta = \left[1 + \sum_{r+2}^{R}\left(\prod_{k=1}^{r-1}\frac{\alpha_{R-K}\gamma_{R-K}}{\mu_{R-K}}\right)\right], \end{gathered} \tag{2}$$

where i(1, 2,...N) is the type of equipment; r(1, 2,...R), number of passes; K, current number of a pass with fixed r; l, amount of finished tubes, m; α, metal consumption coefficient; q, weight of 1 lin. m of tubing, kg/m; C_s, cost of the semifinished product, rubles/ton; C_{wst}, cost of operation of the equipment used at the last pass, rubles/h; P_i, annual operating time

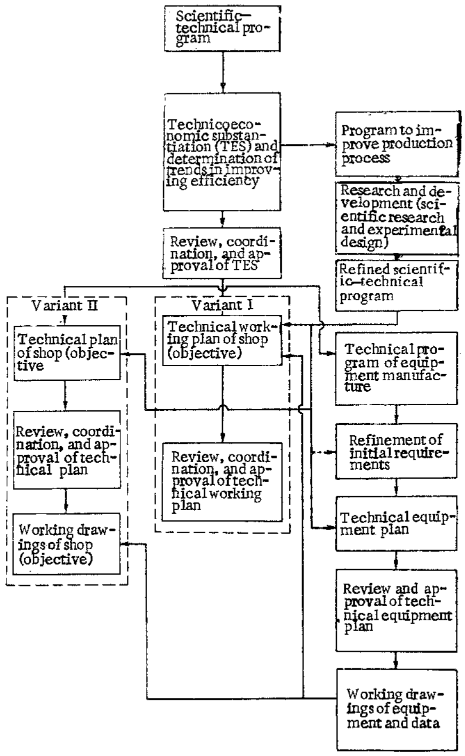

Fig. 2. Improved planning procedures.

of the equipment used at the last pass, h; K_i, capital investment in the equipment, rubles; μ, elongation factor; γ, product mix coefficient; ω, coefficient of the concentration of production (decreases as the annual output of the given shop increases). Studying the effect of the quantities entering into the formula, we can find those factors which must be optimized to achieve the most efficient production.

Using this method for the production of long tubes, we determined the expediency of developing a new semicontinuous tube drawing units with a moving die plate, as well as the technicoeconomic efficiency of its operation.

Studies conducted by VNITI showed that the length and area occupied by a mill with a moving die plate and the weight of the equipment would be 1.5-2 times less than the same parameters for a mill with a stationary die plate. The use of two supports on the endless chain ensures that one of the supports will be returned to the starting position before the drawing operation is completed. This provision substantially shortens the production cycle. The use of an immobile semifinished tube in the drawing operation of the unit provides for counter-tension, which makes it possible to reduce the capacity of the main motor by 10-20% and significantly reduces tube curvature. The latter in turn makes it possible to increase the utilization factor of the heat-treatment facilities and in some cases do away with the straightening operation. The use of counter-tension also eliminates the thickening of the tube wall that occurs in mandrel-free drawing, which makes it possible to reduce the number of deformation cycles.

Use of the proposed planning method has made it possible to improve the technical facilities during planning of the new tube-drawing shop at the Nikopol' Pipe Plant and, with a slight increase in capital expenditures, increase the production of cold-deformed tubing 1.5 times.