

paper will be confined solely to a consideration of the results obtained from the activities described and especially with the methods used for measuring the value of such results.

The simple, complete and proper answer to the question, "How can the results of such activities be measured?" is "by the effect which they have on the prosperity of the industry." Now the prosperity of any industry is influenced by a multitude of factors, and, if we are to determine the effect which any one factor has on the sum total of prosperity, we must first determine and eliminate from the problem the effects produced by all the remaining factors. It does not require a great deal of imagination to realize that the complete solution of this problem is humanly impossible. The best that we can do in trying to answer it is to measure the direct effect on some important element of the sum total of prosperity.

The usual procedure in attempts to measure the results of activities, such as have been described by Mr. Piacitelli, is to consider each operation or process by itself and then show "how" and "how much" the direct labor and materials costs have been, or can be, reduced by changes in methods and equipment. Sometimes the solution is made more complete (or at least more complicated) by having the calculations take into account estimated costs for financing, maintaining and amortizing the equipment and other indirect expenses, as well as potential values due to increased production capacity. These solutions are all very well in their place; certainly no substantial change in methods or equipment should be undertaken without first thus estimating the resulting savings in labor and materials costs and, if the changes involve any considerable initial expense and give a substantial increase in production capacity, then account should also be taken of such indirect expenses and potential values, as have been mentioned. But as a means of reviewing at weekly or monthly intervals the actual accomplishments of changes which have been put into effect, this system is too cumbersome. Nor does it give a complete measure for the effects which the changes have had on even such simple elements of prosperity as reductions in direct labor and materials costs. Thus, for example, materials costs may be reduced by substitution of cheaper goods, or by a drop in market prices. The cheaper substitutes may result in a product which is un-

satisfactory to the customer or consumer, and this would not contribute to the sum total of prosperity of the industry. Labor costs in one or more plant operations may be reduced in such a way that the workmen who are directly affected become dissatisfied. This dissatisfaction spreads until practically all the workers throughout the plant are affected or infected by it. The result will be that the general average efficiency of all the workers will be reduced and total labor costs may be increased, which would detract from the sum total of prosperity. Considerations of this nature led us to discard this customary method for proving the value of results obtained in our plant through the work described by Mr. Piacitelli.

In casting about for some other method of accomplishing what we were after, we started our investigation by formulating a clear conception of the objects which we expected to accomplish by this work. The description of these objects we finally crystallized in the phrase "Elimination of Waste." Waste we then grouped under three classes. One, waste of equipment; two, waste of material; three, waste of labor.

Up to the present comparatively little attention has been given to the waste of equipment, as this problem is largely beyond plant control. Daily and monthly records of the average hourly rate of production for each of the principal machines give a good indication of the efficiency at which the equipment is operated when in use.

Waste of material is measured not in dollar value, but in physical units, such as pounds or gallons. The measure of such waste is the ratio of wasted material to used material, expressed in percentage. This eliminates all variations due to changes in market price of materials or to substitutions of materials, and gives a continuous record of comparable data.

The methods used in measuring results of our efforts in eliminating these two classes of waste are simple and present no unusual features.

The method which we adopted for measuring the results achieved in the elimination of labor waste consists essentially of a comparison of labor input with production output. These comparisons are made monthly.

The labor input is measured by the number of man-hours for which we pay; that is, we take into consideration all the labor throughout the plant,

and not only that part which has been directly concerned with any improved methods or equipment which may have been installed. We are thus enabled to judge whether our work of reducing waste of labor in certain operations has had any effect in getting the workmen throughout the plant to take a greater interest in their jobs and thus bring about the elimination of labor waste on their own account. Our records indicate clearly and conclusively that such improvement in the general attitude and action of the workmen has taken place, and we consider this one of the most valuable results of the work.

The measurement of the production output involved first establishing some arbitrary unit of measure for this complex quantity. The scheme finally adopted measures the area of the principal products. By this scheme we take into account at least eighty per cent of the output, as measured by weight and over ninety per cent of the various products as measured by count. There are, of course, some products which require a great deal more labor effort per unit of area than others, but the proportion of various products to each other remains fairly constant throughout the range of output thus far encountered. This means that our system of measuring the total output does not give abso-

lute values, but does give values which are comparable, when applied to weekly or monthly rates of output.

The following chart, Figure 2, shows the effect of waste elimination on the plant efficiency.

Note the similarity of the two graphs, and that the output per man-hour shows a general and practically continuous rise since the work was started in April, 1924. Before that time it was practically stationary, except for variations due to fluctuations in the volume of business.

It is obvious that this scheme of determining the output per man-hour gives a ratio which is more or less meaningless as a measure of the labor efficiency of the entire plant unless it is considered in conjunction with the volume of the output. This is true because we include in our figures for total man-hours such fixed items as watchmen, firemen, oilers, mechanics, and foremen. For these, the output per man-hour can be increased substantially only by an increase in the volume of output. This is, of course, not accomplished through any one of the activities which have been described by Mr. Piacitelli. We are satisfied, though, that these graphs present a reasonably accurate picture of the savings which have been accomplished as the result of the work described in his paper.

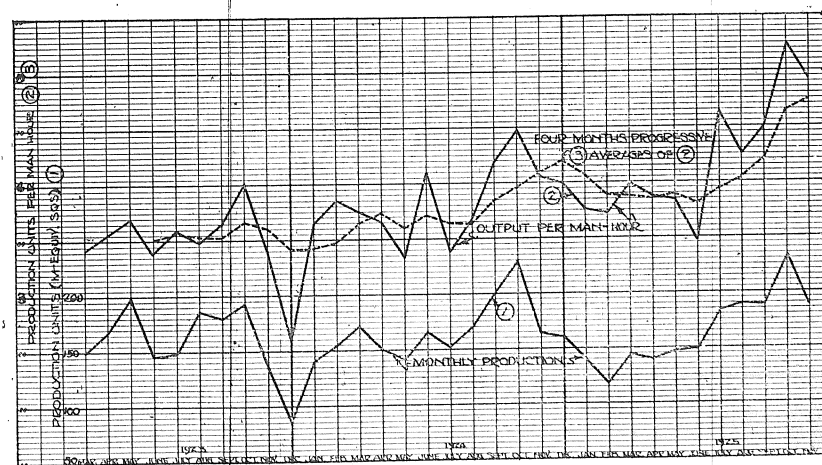


Figure 2