Where materials are simplified into a few classes and sizes, the stores carried on hand will be greatly reduced. Part of the money tied up in raw materials will be released for more profitable purposes. Not only will the store rooms be smaller and the number of men needed to run them be fewer, but also there will more often be material on hand when it is needed. The delays which were formerly caused by the exhaustion of the store of some special, hard-to-obtain material by an unexpectedly large order will be minimized. This is true also of raw castings and supply material.

The effect of standardization on the worker is very marked. The workman will become familiar with his job more quickly if the job is more nearly the same from day to day. He works with the same materials constantly, and he soon learns to get the most out of his machine by using the safe maximum feeds and speeds. When a standard method of procedure has been established and is followed, the operator becomes highly skilled in using this procedure through constant repetition of the same motions. He becomes an expert and, as an expert, will produce more work of a higher quality with less waste, breakage, and lost time than a man working under non-standard conditions.

The method of procedure should be standardized for all lines of work. The elements of all operations should compare favorably and should follow the same line of sequence. In the case of machine work on turret lathes, the same tool arrangement should be made and speeds and feeds should be made to conform. Here the advantages of all possible methods will have been selected and accepted as the standard method of procedure to be followed. Material, tools, and equipment will allow of slight variation and the closest approach to ideal conditions will here be found. This of course is highly desirable and an effort should be put forth in any industrial concern to follow this example.

Supervision is greatly simplified where methods, equipment and design are standard. One foreman can handle more men and will not have to bother with details as he would were he constantly studying new jobs and instructing new workers. Not having this to do, he is able to concentrate on the established work of his department and can devote his time to planning better and cheaper methods for doing it. He is freer to study his men and place them on the jobs for which they are best fitted.

Paper routine is reduced to a large extent by standardization. Record files are smaller, cost systems simpler, and timekeeping easier. The non-productive clerical force is smaller where all work is very nearly standard.

All of these things have the tendency to reduce costs and overhead expense. Non-productive set-ups are minimized, thus allowing the same number of machines to turn out more product or a lesser number of machines to turn out the same product. Lost time, unproductive effort and idle machinery are greatly reduced. A better quality of product is turned out at a lower cost of manufacture, and this product is placed in a more favorable position in the field of competition.

In factories where a single product is manufactured, there will be one or more machines used for a single operation. These will have a special set-up, special tools, and equipment made for a single purpose. There will be as many of these set-ups as there are operations. When a time study engineer has a condition of this kind to deal with, his work is comparatively easy; where the work is more of a jobbing nature, it is a different proposition. In the first case, when the time value is established for an operation, the whole group of machines employed on that operation is taken care of, until some change is made, and it is only a matter of time before time values covering every operation performed in manufacturing the product are set. In the second case, sufficient data must first be collected to cover every condition that may arise, and then this data must be applied to every new job that comes along. The time study engineer should, in the latter instance, try to get his conditions standardized as much as possible. He should have as his ideal the shop that is manufacturing a single product even though he knows that he can never reach that goal. He should realize that, just because the product is varied, it is not necessary to have the same number of variations in tools and equipment. At the same time, he should also keep in mind the desirability of special labor saving conveniences for individual jobs and machines.

There is usually a certain make of machine that has advantages over all other makes of similar machines for doing a certain job. This machine may or may not be available, but there will be among those that are available, one type that will be better than the others. It is not uncommon to see three or four different makes of machines used on the same class of work, and sometimes it is impracticable to control the flow of individual jobs so that they will be performed on the same machine every time they repeat. This condition makes it necessary to determine a time allowance for each machine on which the job may be done, even though this may not be entirely satisfactory.

A good example of this occurred in a machine shop where three radial drill presses were used. On two of these machines the speed in revolutions per minute ranged from seventeen to 240 in seven steps and the feed per revolution from 0.0066 to 0.011 of an inch. On the other machine, the speed in revolutions per minute ranged from forty-four to 474 in twenty-two steps and the feed per revolution from 0.007 to 0.031 of an inch. The advantage that the third machine had over the other two is obvious, and since it was impossible to control the flow of work to the individual machines of the group, the difficulties encountered in establishing time values may be appreciated. It was found that the third machine did approximately thirty-five per cent more work than the other two, and the problem was solved in this case by replacing the first two machines with one of the third type. The two that were taken out were used on other work. Of course, it is not always practicable to do this as the resultant saving may not justify the expense.

All equipment must first be suitable for the work to be done by it. In many cases, it will be found that several different types or makes will turn out the same quality of finished product. The time required to attain this standard of quality may vary widely on the different machines. In purchasing new equipment it is well to select the new in conformity to that type which permits the meeting of inspection requirements in the least possible amount of time. It is sometimes poor business policy, however, to buy all machines from one concern, and as a result, ideal conditions in this respect are seldom realized. This difficulty has been greatly offset of late in the case of machines where many of the characteristics have been standardized and the parts are pretty generally interchangeable.

Conclusion

In conclusion it might be said that analysis, as here applied, deals with the resolving of an operation into its elements for the purpose of discriminating between necessities and non-essentials. By a systematic study of these elements the one best method of performing the operation will suggest itself. This method should then be adopted as a standard to which all similar operations should be made to conform.

The foregoing principles have been closely followed by the East Pittsburgh Works of the Westinghouse Electric & Manufacturing Company for quite some time with very satisfactory results.

Discussion

Howard G. Benedict.[6] The admonition of Frederick W. Taylor regarding the need of standardizing conditions and operations is just as applicable today as when it was presented twenty-five years ago in his paper on "Shop Management" before the American Society of Mechanical Engineers. In all of his work Mr. Taylor emphasized that "The adoption and maintenance of standard tools, fixtures and appliances, down to the smallest item throughout the works and office, as well as the adoption of standard methods of doing all operations which are repeated, is a matter of importance, so that under similar conditions the same appliances and methods shall be used throughout the plant. This is an absolutely necessary preliminary to success in assigning daily tasks which are fair and which can be carried out with certainty. . . . Neglecting to take the time and trouble to thoroughly standardize all of such methods and details is one of the chief causes for setbacks and failure in introducing this system."

When we consider the tremendous strides that have been made in the twenty-five years since Taylor wrote this, and the still further progress that is being made day by day in mechanical processing and in the continuous flow of product through the plants, not only in the automotive but in the countless other industries, it is even more important that we heed this warning today and be sure that we standardize conditions and methods of operation in our departments before attempting to establish tasks and set rates for the accomplishment of these tasks. In the studying of conditions we may use the stop watch or the motion picture machine to determine relative values and detect the extent of present losses, but we should not use them for

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