mated in advance. Having determined the hours to be worked per day, it is then possible to know how many employes of each class will be needed. This is of particular value when the production program is increasing and there is need for training new workers. On a decreasing production program, such a plan is also of value in order that retainer and idle time payment may be at a minimum.

This method of using time studies as a basis for labor planning requires some study and analysis of the indirect or supervisory labor. For example, it may be found that an overseer should also do the work of an adjuster below fifty per cent activity, or the adjuster should also do the moveman's work, or the foreman should attend to clerical or adjusting work below a certain activity.

After establishing the direct and indirect labor man-hour requirements, it is but one more step to have the table show the extension of the hourly task earnings for each class of labor. From this the ratio of the total direct to indirect labor payroll may be extended for various activities of the department and an effort made to keep the ratio as high as possible. If a production greater than one hundred per cent capacity of the shop is temporarily required, such a labor planning chart can show at what point overtime or increased equipment for certain operations will be required. Increments of ten per cent activity from zero to 100 per cent capacity give a useful scale for labor planning data.

It often happens that methods of job analysis and time study have been carried on in a factory or establishment for several years. As with other groups of employes, costly labor turnover will affect the time study organization and a new group of observers may gradually take over the methods-and-times work. This may mean that the new organization will formulate a plan for changing the method of arriving at selected task times. The result will be that the files of the particular organization will have task times or selected minimum times which have been determined by two or more methods. Such an unfortunate situation may lead to the erroneous use of standard times, or additional expense for obtaining new element times. When starting on job analysis and time study in an organization which has already accumulated a large number of standard times careful consideration should be given before changing the customary plan of study which has been in use.

The standardization of methods for determining element times seems almost as impossible as it did to the manufacturer years ago when he was asked to standardize threads for bolts, etc. However, it is believed that the future will show a way for time study observers to get together and formulate the one best plan of arriving at selected times and necessary allowances. There may also be a central organization or group which will receive, index and file standard data and provide a means for its distribution. Through such a means the effect of climatic conditions on the worker will be studied, making due allowance for the same operation performed in the dry cool climates as compared with the hot ones of high humidity.

## Study of Fundamental Operations of a Machine Versus Study of Individual Operations

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### Introduction

IT IS the purpose of this paper to consider the values and difficulties of time studies of fundamental operations as compared with the study of individual operations of a machine.

This discussion is therefore limited to the machine or work of the machine. It follows that much of the functioning of a machine may not be a matter of time study observation, but one of engineering or the development of cutting, forming, or molding data. However, time study does apply to both the points of formation of materials on a machine and its manipulation—to various degrees in various industries. The question then is, when the problem is confronted, "What may be expected from the two methods enumerated above?"

But before getting into this, it may be well to develop a sort of classification of machines in relation to the subject in hand. These classifications are:

1. Machines where both the cutting or forming and manipulation are taken care of entirely by power.

2. Machines where cutting and forming are (both speed and feed) taken care of by power, but the general manipulation is controlled largely by man.



3. Machines where the cutting and forming are either in part or to a large extent controlled by man, and also the general manipulation, or where these are pretty much interwoven with one another and controlled by man.

In the first class, into which we may put most of the power operated and controlled continuous operation machinery, the speeds and feeds are established by engineering, either through engineering department research or from previous information on the subject. The manipulation equipment that controls various functions and conveys material is mechanically controlled to the speed of the major purpose of the machine. It may be argued that all such machinery is subject to time study, and very likely time study is useful at times and can show ways of improving the machine itself. The fundamental operations of such machines, both forming and manipulating, are, however, an inherent part of design, which covers speed, feed, manipulation and time for their performance. This is a subject in itself, but it is interesting in passing to call attention to the way in which the time study attitude has been used in engineering.

There are, of course, at times some features of this class of machinery calling for man manipulation and here the question of time study enters in. This feature will be taken up later on.

Now we come to the classification of machines where cutting and forming are taken care of by power, but general manipulation is controlled by hand. The question of time for actual cutting or forming as in Class 1, is controlled by applied engineering.

In other words, it may be said that in cases of man manipulated but power cutting machines the time for the cutting feature may be semi-automatic, or fixed by engineering, and in other cases by cutting data. Where the machine has varied cutting speeds and feeds the time is established from engineering data charts, not from time study.

Here, as in the first class, there are variations from this general rule. At times, where no data are available, time study may be used as a medium of research and establishment of data.

These machines are either manipulated by hand movement or are hand controlled and power moved. The old machine tools, entirely hand moved, and the later designs with power rapid traverse, are good illustrations of these cases.

The question of manipulation is a problem of time study, whether the part is or is not partly moved by power. Those elements of time in the manipulation of machine parts other than cutting action, when served by power, should go back to engineering calculation as a rule, because they depend upon speeds established by machinery.

We now come to Class 3, machines where the cutting and forming are either in part or to a large extent controlled by man. Here time study must function largely. It must decide the correct time for control of cutting and manipulation. It very often leads to research in the cutting or forming operations which in turn at times provides distinct data for these elements.

So far an attempt has been made to present the problem of time study in connection with various classes of machinery. In this presentation it has been brought out in part that engineering in the case of continuous, automatic and semi-automatic machinery covers the problem of time for forming the product, and that in other cases organized data for machines of various speeds and feeds used on a range of products cover the question of time for forming the product.

It is of interest to digress for a moment to think how improvement in machinery during the past fifteen or twenty years has covered much of the field formerly solved by time study or, what is still better, not solved at all. There is a point here that is of especial interest in connection with the subject. Where engineering has rather thoroughly covered items of time in the design of machinery it has learned possibilities of fabrication and built standards of machinery around these possibilities. It may be said that it has developed, through the means of research, possibilities of performance and established machinery to carry out these possibilities. Engineering works from the desirable and possible, not entirely from the existing. Time established by engineering is always closely related to other standards. Is this not a key to the solution of problems of time study? In the development of engineering, where time of forming and manipulation is important, there is no doubt that engineering has learned from the time study of the past. Now, does not engineering point to better ways of time study? Does it not point to the salient principles that should underlie all our time study practice?