

the management covering a four week period, beginning with the current weeks. These available capacities are changed as the equipment or personnel varies.

The weekly available capacity of all classes of machines, operators and tools is determined by ascertaining the number of hours the plant is operating in a week and multiplying this by the number of machines, operators or tools available.

In determining the available machine capacity due allowance should be made for unavoidable idleness, such as time required to supply sufficient steam pressure to dry cans in finishing plants before they are started each morning. Similarly, proper allowance should be made for special machinery which is used only at intermittent periods, such as extra large planers for certain work in machine shop practice.

Likewise, in ascertaining available labor capacity a proper allowance should be made for absentees.

Ordinarily no allowance is necessary in determining available tool capacity, especially in plants where through a modern central tool room all special tools are constantly maintained in usable condition.

For balance of work purposes the available quantities should represent the actual net available manufacturing capacity in all cases, so that when comparing work assigned to capacity available no deduction is necessary to ascertain how far ahead equipment is booked for current orders or the earliest time at which manufacturing capacity is available.

Using the existing route sheets and manufacturing schedule as a guide, balance of work tickets are prepared for each operation of every lot or order as follows:

One machine ticket (Fig. 4) for each operation to be done; this ticket contains the order symbol, name of operation, quality, bonus time allowed, the date by which the operation is scheduled to be completed and the machine class symbol.

One labor ticket (Fig. 4) for each operation to be done containing the order symbol, name of operation, quality, bonus time allowed, the date the operation is scheduled to be completed and the labor class symbol.

One tool ticket (Fig. 4) for each operation requiring such special tools for which a balance of work statement is to be submitted, containing the order symbol, name of operation, quantity, bonus time allowed, the date by which the operation is scheduled to be finished and the tool class symbol.

These forms should be so designed as to permit their preparation on a duplicator and from the same original from which time tickets, move orders, inspection tickets, etc., are made.

A balance of work report (Fig. 5) is used in submitting weekly balance of work statements to the general manager, employment manager and mechanical superintendent and such other executives as may be designated.

The report is divided into three major sections, one each for machines, labor and tools. Each of these sections is sub-divided into minor sections as follows: Class, 1st week, 2nd week, 3rd week, 4th week. Each of the twelve weekly sections has two columns, one headed "Available" and the other "Assigned."

The various permanent machine and labor class symbols are listed in the class columns in such fashion as to segregate machines by classes of employees operating them. The tools are listed by classes regardless of the class of machine or operators using them, since a special tool may be required by a number of different classes of machines and operators.

The balance of work here described used the hook type board and is operated in a plant controlled from a central Planning Department using route sheets, schedules and times cards and having bonus time allowed factors available.

As balance of work tickets are prepared they are arranged on the board by machine, labor and tool classes and according to weeks in which the jobs they represent are scheduled to be completed, thus indicating work assigned to various classes of manufacturing capacity by weeks, but which has not yet been completed.

As finished time cards are received they are used as authority to remove their corresponding balance of work tickets from the board, all remaining balance of work tickets, therefore, represent jobs assigned but not completed. This particular arrangement of the balance of work tickets offers a very simple and satisfactory means of compiling lists of jobs scheduled but not yet completed, and is especially valuable in making statements of jobs not being kept up to schedule. Usually a more laborious method is necessary to properly ascertain which jobs, if any, are overdue. Sometimes it is done by actually referring to a large number of route sheets or schedule sheets, and, depending on the number of sheets to which it is necessary to refer, is more or less inaccurate.

At the end of each week (or oftener if desired) the balance of work report is prepared and the entries thereon are supported by the information on the board and on the balance of work tickets arranged on the board.

The actual work assigned to each class is entered in the four assigned columns, one column for each week.

This information is obtained by totalling the time periods or quantities appearing on all balance of work tickets on the board at the time.

Assigned quantities exceeding available quantities are entered in red so as to emphasize this condition whenever and wherever occurring. The balance of work reports may be used to great advantage in plotting curves to demonstrate in condensed form the fluctuations of work ahead of the factory and historically represent "feast or famine" conditions.

This feature has an important bearing on the determination or changing of policies in connection with attempts to minimize periodic unemployment in industries engaged in a seasonal business.

It is really surprising to note the conditions usually shown by the adoption of the balance of work method.

A certain cotton goods finishing plant was being operated in such fashion as to practically guarantee that the prescribed tonnage was put into process in the grey room, but without proper regard to the condition of the departments subsequent to bleaching. The management was proud of the fact that the required quantity of goods was put in each day, but could not understand why the finishing departments were constantly overloaded and that only by superhuman effort on the part of the foremen and constant urging by the Sales Department it was possible to give the howling customers anything like even periodic service; nor did it appreciate the reasons for the tremendous quantity of goods in process at all times with the natural congestion in the factory, shortage of trucks and abnormal amount of soiled or otherwise damaged material.

By the introduction of the balance of work, the condition improved and the policies of the plant were changed to such an extent that goods were more intelligently put in and therefore more economically finished and the service to the customers improved.

The management was also convinced that there is an advantage in reducing tonnage put in on certain days, since the disadvantages resulting in the bleachery were more than offset by advantages in the finishing departments.

The proper operation of the balance of work makes it possible to visualize conditions in the entire plant just as the planning board makes it possible to visualize conditions in any specific department insofar as work ahead of individual machines is concerned.

The balance of work offers finally a simple but effective means of submitting condensed statements of conditions to the executives for any period desired, and

these reports when intelligently studied offer scientific data which should and usually do make it possible to operate an industry more nearly as it should be to insure greater production, higher wages, lower costs, proper working hours and better service to customers, and thus prepare it for the rapidly returning days of competition.

DISCUSSION

H. K. HATHAWAY:¹ As Mr. Hemmerly points out, that feature of scientific management mechanism known as the balance of work has not received discussion or attention commensurate with its importance. It is not a new problem, however, for as Mr. Hemmerly will no doubt recall, he and I struggled with it some fifteen years ago under the guidance of Mr. Barth and Mr. Taylor, who long before that had known its importance and developed certain methods for meeting the need. In few plants has it been so carefully worked out and applied as have other features—such as routing or stores control. Usually some makeshift is devised, and made to suffice. One possible explanation of this condition is perhaps that inertia or a sense of helplessness on the part of those in the management, upon whom correction of faulty conditions shown up by the balance of work depends, discourages its further development. I have seen cases where the production clerk, or superintendent of production kept on presenting to the officials conditions crying for correction which were brought to light by the balance of work, but to no avail. Another reason may be that in a large measure the Planning Department bulletin board (or planning board as Mr. Lichtner has suggested it be renamed) affords in itself a large part of the information required. As generally operated it shows for each machine or work-place (a) jobs at machine or work-place ready to be done; (b) jobs ahead for which material is on hand, not yet ready to be done (i.e., having preceding operations yet to be performed). The operation orders may be made also to show, as in the mechanism described by Mr. Hemmerly, the period during which the work should be done, without which a balance of work is not very satisfactory so far as making promises is concerned, especially in a business where some of the customers' orders are received considerably in advance of the delivery dates wanted. Even then, however, the Planning Department bulletin

¹Consulting Engineer in Management, Philadelphia.