

tenance of physical standards, functional organization, selection and training of personnel, a system of planning and control, and all the other services auxiliary to production and management as well as sound industrial relations. He was quick to see the need for all these and to supply them.

Much present-day practice of time study and the utilization of its results are open to criticism, and this is due, I believe, to a failure to understand fully the objects and governing principles as Taylor conceived them. If one has lost one's way, it is sometimes best to go back to the starting point to get one's bearings. I believe every methods man will be helped by a more discerning reading of the Taylor and Gantt papers to which I have referred, followed by an unbiased checking up of his own practice.

II. Principles and Purposes of Methods Study

All that is reflected or implied by the foregoing may be summed up in the following statement of what appear to me to be the fundamental principles by which methods study should be governed.

1. Critical analysis of work to be done and its reduction into elementary component operations.

2. Comparison of the method, equipment and conditions governing the work being studied with, so far as it can be ascertained, the best existing practice followed elsewhere and the facilities pertaining thereto.

3. Study of the process for the purpose of ascertaining opportunities for improvement through the elimination of uncertain factors; waste of effort; fatigue; waste of time resulting from faulty technique, unstandardized conditions, faulty materials, obsolete or unsuitable machinery and machine accessories, inconvenient arrangement, poor surrounding conditions or inadequate auxiliary service to workers engaged in the process.

4. Establishment, as a result of analysis, comparison and study, of equipment, tool and product standards—in short, standards applying to all the physical conditions governing performance of work—which will represent the best that can be obtained or devised, consistent with the practical and economic limitations governing at the time.

5. Obtainment of the interested and hearty cooperation of the worker through explanation of the purposes and effects of methods study and through demonstration of the beneficial objectives of this and related features of scientific management, particularly as they have a bearing upon his own welfare and

interests, in order that his share in the undertaking may be most effective.

6. Study of the elements of personal skill, effort and their physical and mental effects upon the worker, as these are involved in the process, with a view to adopting as standard a method which is compatible with the worker's well-being and which embodies the collective best practice and experience of various workers in the same craft.

7. Development and adoption as standard, after analysis, study and experiment, of a method which will represent, under standard governing circumstances and conditions, the best that can be devised at the time, with due regard to quality of product, economy in utilization of material, effect upon machinery and tools, upon other indirect as well as direct cost factors, and the welfare of the worker.

8. Establishment of a task or performance standard that represents, under the standardized conditions and equipment, the time that it should take a "first-class worker" to do the work in question as indicated by properly made elementary time studies.

9. Provision of adequate means and suitable organization for the maintenance of the standardized conditions and auxiliary services upon which the attainment of performance standards depends.

It will be apparent from the foregoing that many factors involved in the problem of establishing a standard method may fall outside what we ordinarily consider the field of a time-study man, or even of a methods department. Finance, volume of sales, design, raw materials, plant equipment and its arrangement, organization, mechanisms or systems of management and industrial relations, all may have weight in deciding upon the best method and upon the worker's accomplishment. It will, I believe, also be seen that what I have stated in an attempt to formulate the principles underlying methods study, is consistent with and involves the four basic principles of scientific management as stated by Taylor. Dr. Person has recast these under the headings of Management Research, Management Standards, Management Control and Cooperation.

Quoting from my chapter on "Control of Shop Operations" in "Scientific Management in American Industry":⁴

The control of shop operations or the planning and direction of work, as it may better be identified, comprises three major

⁴Pp. 319-320.

objectives: (1) predetermining what is to be done, how it is to be done, what facilities and materials are to be employed, and when it is to be done; (2) providing and bringing together at the right time the material, the facilities, the requisite information and the qualified worker; (3) providing such auxiliary assistance, service and supervision as may be essential to the successful and economical accomplishment of the work.

The first of these—the predetermination of what, when and how—starts with the provision of drawings, specifications, models or samples, the object of which is to show, in a manner that will preclude the possibility of error or misunderstanding, the nature of the article to be produced or the service to be performed. In many lines of manufacture, particularly in the metal trades, it has long been the practice to provide mechanical drawings, but it has only been within recent years that there has been an appreciation of the full purpose that drawings should serve and of the information they should convey—in short, of the fact that the main purpose of drawings is to answer every question that might arise as to just what is required.

When the basic information as to what is to be done has been provided, the next step is to determine how the work is to be done, what facilities are to be utilized, and what materials will be needed at each stage of the work. This would include what are in most instances of scientific management regarded as two distinct major functions of a properly organized planning department; namely, "routing," and the preparation of detailed instruction cards defining the manner in which individual operations are to be performed. The latter of these two functions, or stages, in the planning of work is in reality a continuation of the first.

These two functions of planning call for the previous establishment of certain features of the Taylor system that are essentially preliminary and auxiliary to the functions in question. Without these, effective planning will be found difficult if not impossible. They are: (1) rearrangement of machinery or such other equipment as may be necessary to facilitate the storage of materials (jobs ahead) at the various machines or work places and its movement from operation to operation, greater independence in the use of machines and of personnel, and so on; (2) the establishment of a store room and a system for its operation or, as today few plants are found totally lacking in this respect, the development or modification of existing store rooms and systems to meet the requirements of routing and of centralized control; (3) development of the order system—including shipping orders and manufacturing orders; (4) development or modification of the balance-of-stores or stock-record system so that it may not only be a record of transactions and of what is on hand in the store rooms, but also a live agency regulating the procurement of materials and feeding work to the shop; (5) provision of suitable information relating to the product to be manufactured; in the shape of drawings or specifications, showing as a basis for routing the materials required and what is to be done; (6) standardization of machinery, tools and other facilities, and the availability in the planning department of codified data in regard thereto.

The influence of that unit of an organization which

decides upon standard methods extends to all other units. It may be, as it has been in the past, the instigating force in standardization of parts and of draughting practice in engineering industry; it may and does, although sometimes in a rather crude way, influence, if not govern, the design of special machinery or even details of general purpose machines; it may be a factor in determining sales policies and the products to be manufactured.

The purpose of time study, even when thought of in its broader sense, has been too generally regarded as limited to the establishment of production standards and to the determination of a basis for an incentive wage system. This is in part due, as I have suggested, to the misplacing of emphasis in the earlier writings on the subject, and in part due to the persistence of a limited understanding of the interdependency of the various functions of management. In addition to its influence upon other branches of management and to serving what may be regarded as its primary purposes, it serves an important group of secondary purposes in the conduct of a business. These include planning and scheduling work for men and machines, estimating costs and predicting delivery dates, balancing labor forces, etc.⁵ These important secondary purposes were well understood and utilized by Taylor and his associates when I joined the group in 1904.

III. Qualifications of Men to Undertake Methods Study

Just as there is need for a standard with respect to workmen whose performance is to be studied and for whom tasks are to be set, there is need for a more uniform and definite specification of the qualifications of the individuals who are to undertake methods study. In "A Piece-Rate System" Taylor makes no comments on the men who made the early studies that served as a basis for elementary rate fixing at Midvale. We know, however, that they were men of ample practical experience coupled with education above that of the average workman of that day. Taylor states that time studies of handling pig iron at Bethlehem were made by "an intelligent college man who had not be-

⁵For detailed treatment of these uses of the results of time study I would refer you to: "Smoothing the Wrinkles from Management: Time Study the Tool" by Sanford E. Thompson, *Bulletin of the Taylor Society*, Vol. XIII, No. 3, April, 1928; "The Taylor Technique of Time Study" by Dwight V. Merrick, *Bulletin of the Taylor Society*, Vol. XIII, No. 3, June, 1928; "Planned Control" by William O. Lichtner, The Ronald Press, New York, 1921; "Balance of Work" by William D. Hemmerly, *Bulletin of the Taylor Society*, Vol. V, No. 3, June, 1920.