

I. AN INDICTMENT OF STOP-WATCH TIME STUDY<sup>1</sup>By FRANK B. GILBRETH AND L. M. GILBRETH<sup>2</sup>

Planning and control and all other functions of management depend first, last and all the time upon the standards on which they are based. These standards, in turn, depend upon the fundamental data from which they are derived. The fundamental data for determining standards are obtained by motion study and time study.

2. Dr. Taylor said: "What the writer wishes particularly to emphasize is that this whole system rests upon an accurate and scientific study of 'unit times,' which is by far the most important element in modern management."<sup>3</sup> We wish to give additional emphasis to his words—"accurate" and "scientific."

3. At the time that Taylor wrote this, in 1903, in his classic "Shop Management," professional paper No. 1003, Transactions of the American Society of Mechanical Engineers, the stop watch was the most accurate device and method extant. Today the stop watch is known to be vastly inferior to the method of timing and recording the motions and the attending conditions simultaneously.<sup>4</sup> It has been proved absolutely worthless and also misleading so far as assisting in skill study is concerned.<sup>5</sup> It is unethical because it does not clearly define the subject matter of an implied contract on which the wage payment is based, and it is economically wasteful because it does not preserve the best that has been done.

4. It is the validity of data accumulated by the usual use of the stop watch time study methods that we are assailing in this paper.<sup>6</sup>

5. Every statistician knows, and to most students of science it would seem almost axiomatic, that *final averages are no more accurate than the data from*

<sup>1</sup>Full title:—"Time Study and Motion Study as Fundamental Factors in Planning and Control: An Indictment of Stop-Watch Time Study."

<sup>2</sup>Consulting Engineers, Montclair, N. J.

<sup>3</sup>A. S. M. E. edition, paragraph 133, Harper edition, page 58. This differs here from the A. S. M. E. in omitting the parentheses from *unit times* and in changing *modern* to *scientific*. See also "Shop Management," A. S. M. E., paragraphs 154, Harper edition, page 65, and A. S. M. E., paragraphs 323-324, Harper edition, page 148.

<sup>4</sup>"Applied Motion Study," Macmillan & Co., pages 62 and 82.

<sup>5</sup>"Motion Study for the Handicapped," E. P. Dutton & Co., page 70.

<sup>6</sup>For description of other basic defects, see "Fatigue Study" and "Psychology of Management," Macmillan & Co.

*which they are derived.* It is therefore a fact that the accuracy of the standards of Planning and Control can be judged and estimated by the degree of accuracy of their fundamental data, and that effective planning and control, which involve the factors of permanence and maintenance, depend upon the validity and accuracy of the original data from which they are derived.<sup>7</sup>

6. Apparently in ignorance of this fact—papers and books have been written on Time Study in which are advocated the practice and method of crossing out, and discarding, times recorded by the inaccurate stop watch method, which at the time the time study data are worked up are *guessed* to be "abnormal," because they seem to be much higher or much lower than the others. In these papers and books is recommended the practice of making arithmetical calculations based upon averaging the remaining times to the fourth decimal, or *the ten-thousandth of a minute*, although the watch on which the original readings or pressings were made had no divisions smaller than a hundredth of a minute, and no observer claims that his records are always accurate to a fiftieth of a minute.<sup>8</sup>

7. This Society has spent much effort in standardization. It is especially to be congratulated on the choice of subject of Mr. Lichtner's paper delivered on the subject recently, which presents the necessity of deriving standards, and not only calls upon this Society to do something definite, but suggests that such fundamentals as definitions of terms become the subject of discussions and final agreement.<sup>9</sup>

8. It is to be regretted that up to today not one single standard has been made from the results of precise measurement by this Society, in spite of the fact that Taylor wrote, in 1903, "The adoption and maintenance of standard tools, fixtures and appliances, down to the smallest 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

<sup>7</sup>Willford I. King, "Elements of Statistical Method," Page 76, "The total can be no more accurate than the most faulty item." Page 77, "The absolute accuracy of a total can be no greater than that of the most inaccurate item composing it."

<sup>8</sup>Dwight V. Merrick, "Time Studies for Rate Setting," The Engineering Magazine Co., page 8.

<sup>9</sup>William O. Lichtner, "Promulgation of Standards by the Taylor Society," Rochester, N. Y., May 7, 1920.

with certainty."<sup>10</sup> Taylor also says, "It would seem almost unnecessary to dwell upon the desirability of standardizing, not only all of the tools, appliances and implements throughout the works and office, but also the methods to be used in the multitude of small operations which are repeated day after day."

9. At the time of the presentation of Mr. Lichtner's paper, we objected to many parts of it and particularly to his definitions of various terms which involved time study and motion study, and their likenesses and differences. What Mr. Lichtner has described as motion study has no resemblance to what we had, or still have in mind, when we coined the phrase, "motion study." We have since supplemented this criticism, which aims to be most definite and constructive, by an indictment of stop watch time study made before the Society of Industrial Engineers at the recent meeting in Pittsburgh, and we shall take his paper up in detail later. Believing, however, that such an indictment should also be made in definite and detailed form before this Society, whose members are fitted by training and experience to appreciate the vital importance of the subject and to judge as to the justness of the criticism, we are today presenting this subject in summary form for your consideration. The data upon which our conclusions are based have been and are still at your disposal. A more lengthy presentation of the subject is in preparation, and that will soon be at your disposal also.

10. You undoubtedly are aware that the usual theory and practice of stop watch time study, as generally practiced, is as follows: The time that it takes "a first-class worker" or "the average worker" to do a piece of work by the usual method is obtained by using inaccurate methods and devices. The records obtained through such timing are submitted to varying processes of arithmetic in which the utilization of "averages" of incorrect data forms an important part in the calculation, with the result that the final data are not correct and neither do they define nor describe nor record the method of work which they time.

11. According to those who still advocate and use the stop watch method of time study only, the time taken to perform the work is the most important element of the final standard, this time being calculated from an "average" time for performing the work.<sup>12</sup>

<sup>10</sup>"Shop Management," A. S. M. E., paragraph 269, Harper, page 116.

<sup>11</sup>"Shop Management," A. S. M. E., paragraph 284, Harper, page 123.

<sup>12</sup>Merrick, "Time Study for Rate Setting," Chapter 1, paragraph 1.

12. We attack the validity of standards for planning and control derived according to any method based on or that uses the practice of averaging inaccurate data, and we attack the validity and the scientific value both of the method and of the results. This constitutes our definite criticism. We base this attack upon stop watch time study, for example: as described in "Time Studies for Rate Setting," by Dwight V. Merrick, copyrighted by the executor of the estate of Frederick W. Taylor, with a foreword by Carl G. Barth, and published 1919. This book, it will be noted, is by a recognized authority in stop watch time study, of recent date, introduced and indorsed by the Taylor Co-operators. It is a masterly presentation of the entire case for stop watch time study—authoritative, detailed and exhaustive, and reflects great credit upon the painstaking effort of the author.

13. In Mr. Barth's foreword, and in Mr. Merrick's preface to his book, and also in Chapter 1, "Objects and Principles of Time Study," and Chapter 2, "Taking An Operation Time Study," are set forth the underlying principles and the accepted practice of stop watch time study. In these first nineteen pages, the following defects in such study from the scientific standpoint are some of those which are noted:

14. Time studies are made of workers *not* extraordinarily expert. (Barth page IX. "It is at all times easiest and best to make observations on a first-class, but not extraordinarily expert operator.")

15. The data are inaccurate. (Merrick, page 8. "An error in reading the stop watch may easily equal the elapsed time for the performance of the particular element under observation.")

16. The quality and ability and suitability of the man observed has not definitely been recorded. (See figures 1, 3, 9, etc.)

17. Judgment instead of measurement is used when a mediocre worker is observed, or when "soldiering" is suspected. (Page 5-6. "The experienced observer, acquainted with the character of work, with effective and efficient methods of performing simple manual and mechanical operations, and who is also a keen student of human nature, soon learns to recognize with certainty any tendency on the part of the operators not to do their best and to make due allowances for the resulting inefficiencies, etc.")

18. Judgment, not measurement, determines the number of observations to be taken. (Page 12. "The requisite number of observations is a matter which has to be left to the judgment of the time study man.")