FRANK GILBRETH

Frank Bunker Gilbreth was a bricklayer by trade, and it was during his early career as a contractor that he worked out his Bricklaying System and became interested in improving methods generally.

Frank Gilbreth's tremendous energy and capacity for organization was largely responsible for the development of motion study and its inclusion as a basic portion of scientific management. He and his wife, Lillian, were responsible for the introduction of various special charts and the use of motion pictures to help analyze, study, and improve jobs. They were both interested in the employee as an individual and placed considerable emphasis upon the psychological factors in management. Upon the untimely death of Frank in 1924, Mrs. Gilbreth carried on their work alone.

Gilbreth's book, *Motion Study*, was published in 1911 and presented a general outline of the field as well as the many variables which are present in work with motion studies. Chapter I of that book is reproduced below. His paper, "Science in Management For the One Best Way to Do Work", was presented in Milan, Italy, in 1922, and is a comprehensive statement of his beliefs. Of particular significance is his philosophy of the "One Best Way" which is extracted from that paper and presented here.

Description and General Outline of Motion Study

NECESSITY FOR MOTION STUDY

Professor Nathaniel Southgate Shaler astounded the world when he called attention to the tremendous waste caused by the rain washing the fertile soil of the plowed ground to the brooks, to the rivers, and to the seas, there to be lost forever.

This waste is going on in the whole civilized world, and especially in our country. Professor Shaler's book, "Man and the Earth," was the real prime cause of the congress

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Reprinted from the book, Motion Study, by Frank B. Gilbreth, Chapter I, pages 1-9, published by D. Van Nostrand Company, New York, 1911.

that met in Washington for the conservation of our natural resources. While Professor Shaler's book was right, and while the waste from the soil washing to the sea is a slow but sure national calamity, it is negligible compared with the loss each year due to wasteful motions made by the workers of our country. In fact, if the workers of this country were taught the possible economies of motion study, there would be a saving in labor beside which the cost of building and operating tremendous settling basins, and the transporting of this fertile soil back to the land from whence it came, would be insignificant. Besides, there would still be a surplus of labor more than large enough to develop every water power in the country, and build and maintain enough wind engines to supply the heat, light, and power wants of mankind.

There is no waste of any kind in the world that equals the waste from needless, ill-directed, and ineffective motions. When one realizes that in such a trade as bricklaying alone, the motions now adopted after careful study have already cut down the bricklayer's work more than two-thirds, it is possible to realize the amount of energy that is wasted by the workers of this country.

The census of 1900 showed 29,287,070 persons, ten years of age and over, as engaged in gainful occupations. There is no reason for not cutting down the waste motions in the vocations of the other almost half (49.7 per cent) of the population ten years of age and upward who do not engage in gainful occupations. The housekeepers, students, etc., on this list have as much need for motion saving as any one else,--though possibly the direct saving to the country would not be so great. But taking the case of the nearly thirty million workers cited above, it would be a conservative estimate that would call half their motions utterly wasted.

As for the various ways in which this waste might be utilized, that is a question which would be answered differently by each group of people to whom it might be put.

By motion study the earning capacity of the workman can surely be more than doubled. Wherever motion study has been applied, the workman's output has been doubled. This will mean for every worker either more wages or more leisure.

But the most advisable way to utilize this gain is not a question which concerns us now. We have not yet reached the stage where the solving of that problem becomes a necessity--far from it! Our duty is to study the motions and to reduce them as rapidly as possible to

standard sets of least in number, least in fatigue, yet most effective motions. This has not been done perfectly as yet for any branch of the industries. In fact, so far as we know it, it has not, before this time, been scientifically attempted. It is this work, and the method of attack for undertaking it, which it is the aim of this book to explain.

PLACE OF MOTION STUDY IN SCIENTIFIC MANAGEMENT

Motion study as herein shown has a definite place in the evolution of scientific management not wholly appreciated by the casual reader.

Its value in cost reducing cannot be overestimated, and its usefulness in all three types of management--Military, or driver; Interim, or transitory; and Ultimate, or functional--is constant.

In increasing output by selecting and teaching each workman the best known method of performing his work, motion economy is all important. Through it, alone, when applied to unsystematized work, the output can be more than doubled, with no increase in cost.

When the Interim system takes up the work of standardizing the operations performed, motion study enables the time-study men to limit their work to the study of correct methods only. This is an immense saving in time, labor, and costs, as the methods studied comply, as nearly as is at that stage possible, with the standard methods that will be synthetically constructed after the time study has taken place.

Even when Ultimate system has finally been installed, and the scientifically timed elements are ready and at hand to be used by the instruction card man in determining the tasks, or schedules, the results of motion study serve as a collection of best methods of performing work that can be quickly and economically incorporated into instruction cards.

Motion study, as a means of increasing output under the military type of management, has consciously proved its usefulness on the work for the past twenty-five years. Its value as a permanent element for standardizing work and its important place in scientific management have been appreciated only since observing its standing among the laws of management given to the world by Mr. Frederick W. Taylor, that great conservator of scientific investigation, who has done more than all others toward reducing the problem of management to an exact science.

VAST FIELD FOR MOTION STUDY

Now tremendous savings are possible in the work of everybody,--they are not for one class, they are not for the trades only; they are for the offices, the schools, the colleges, the stores, the households, and the farms. But the possibilities of benefits from motion study in the trades are particularly striking, because all trades, even at their present best, are badly bungled.

At first glance the problem of motion study seems an easy one. After careful investigation it is apt to seem too difficult and too large to attack. There is this to be said to encourage the student, however:

1. Study of one trade will aid in finding the result for all trades.

2. Work once done need never be done again. The final results will be standards.

PRESENT STAGE OF MOTION STUDY

We stand at present in the first stage of motion study, i.e., the stage of discovering and classifying the best practice. This is the stage of analysis.

The following are the steps to be taken in the analysis:

1. Reduce present practice to writing.
2. Enumerate motions used.
3. Enumerate variables which affect each motion.
4. Reduce best practice to writing.
5. Enumerate motions used.
6. Enumerate variables which affect each motion.

VARIABLES

Every element that makes up or affects the amount of work that the worker is able to turn out must be considered separately; but the variables which must be studied in analyzing any motion, group themselves naturally into some such divisions as the following:

I. Variables of the Worker.

1. Anatomy
2. Brawn
3. Contentment
4. Creed
5. Earning Power
6. Experience
7. Fatigue
8. Habits
9. Health
10. Mode of Living
11. Nutrition
12. Size
13. Skill
14. Temperament
15. Training

II. Variables of the Surroundings, Equipment, and Tools.

1. Appliances
2. Clothes
3. Colors
4. Entertainment, music, reading, etc.
5. Heating, Cooling, Ventilating
6. Lighting
7. Quality of material
8. Reward and Punishment
9. Size of unit moved
10. Special fatigue-eliminating devices
11. Surroundings
12. Tools
13. Union rules
14. Weight of unit moved

III. Variables of the Motion.

1. Acceleration
2. Automaticity
3. Combination with other motions and sequence
4. Cost
5. Direction
6. Effectiveness
7. Foot-pounds of work accomplished
8. Inertia and momentum overcome
9. Length
10. Necessity
11. Path
12. "Play for position"
13. Speed

In taking up the analysis of any problem of motion reduction we first consider each variable on the list separately, to see if it is an element of our problem.

Our discussion of these variables must of necessity be incomplete, as the subject is too large to be investigated thoroughly by any one student. Moreover, the nature of our work is such that only investigations can be made as show immediate results for increasing outputs or reducing unit costs.

The nature of any variable can be most clearly shown by citing a case where it appears and is of importance. But it is obviously impossible in a discussion such as this to attempt fully to illustrate each separate variable even of our incomplete list.

Most of our illustrations are drawn from bricklaying. We have applied motion study to our office and field forces, and to many of the trades, but our results on bricklaying are the most interesting, because it is the oldest mechanical

trade there is. It has passed through all the eras of history, it has been practiced by nations barbarous and civilized, and was therefore in a condition supposed to be perfection before we applied motion study to it, and revolutionized it.

Since first writing these articles for Industrial Engineering it has been of great interest to the writer to learn of the conscious and successful application of the principles involved to the particular fields of work that have interested various readers. It was thought that unity might be lent to the argument by choosing the illustrations given from one field. The reader will probably find himself more successful in estimating the value of the underlying laws by translating the illustrations into his own vacabulary,--by thinking in his own chosen material.

The practical value of a study such as this aims to be will be increased many fold by cooperation in application and illustration. The variables, at best an incomplete framework, take on form and personality when so considered.

Science in Management for the One Best Way to Do Work

Motion study, fatigue study, skill study, and time study are methods of measurement under the science of management, and without them it is absolutely impossible to find the One Best Way to do work, or to make and enforce the super-standards and programs for the benefit of all. These have application in every field, are closely related, and must receive attention at the proper periods in the installation of scientific methods of management.

Extracted from the pamphlet, Science in Management for the One Best Way to Do Work, by Frank B. Gilbreth. Published by Societa Umanitaria, Milan, 1923. Paper presented at Illeme Conference Internationale de Psychotechnique Applique a l'Orientation Professionelle, Milan, Italy, October 2-4, 1922.

Motion Study

Motion study is a method of increasing the efficiency of the worker. It is the science of determining and perpetuating the scheme of perfection; the performing of the One Best Way to do work.

Fatigue Study

Fatigue study is a first step in motion study. It is the investigation of the causes and opportunities for the elimination of unnecessary fatigue, and the provision of rest from necessary fatigue. It is unreasonable to expect to obtain hearty cooperation in matters where the workers have not received proper consideration as to the elimination of their unnecessary fatigue.

Skill Study

Skill study is an inquiry into the causes of, and the best way of acquiring and transferring, skill. It is a subject that affects everyone, whether he is apprentice, journeyman, laborer, manager, employer, or stockholder,--and also the customer. The accuracy of the method of working leads to the accuracy of the resulting workmanship. Too much emphasis during the learning period cannot be laid upon the importance of correcting the erroneous practice of saving material at the expense of later interference of habits of motions, and the postponement of the day of utilization of automaticity of decision as well as motions. In no other way can super-standardization of tools and working conditions be enforced so well as by putting the emphasis on the accuracy of methods to be used from the beginning. In no other way can such rapid fitness for promotion be achieved. In no other way can the best way known be improved by those who have the greatest craft skill and craft knowledge. We advocate the transference to other work of all trade teachers who do not appreciate this scientific fact as a prime requisite for fitness to teach the beginners in the arts, trades, and crafts. The practice of allowing the average method to be taught by the average teacher should be discouraged and abolished wherever possible, and the practice of having the One Best Way taught by the best teacher available should be encouraged by everyone. There have been no careful and systematized attempts by any nation to collect information about skill, similar to the attempt to find the best wheat, yet the field for synthesizing elements of skill offers opportunities of more importance to mankind than the cross fertilizations resulting in Marquis Wheat. There has been no nation or city that has had a definite system for conserving such information if it were offered to it. Rarely can a man be found who is able to distinguish skill of method from high speed of output in arts and crafts and trades. The workers of the world can now make anything.

Let the emphasis now, during the learning process, be on the method and not on the accuracy of the resulting product. This is a problem in psychology, but apparently very few psychologists have more than remote idea of what it is, yet it has been already proved by measurement, time and time again, and solved to the point of standardization.

The best way to conserve the skill of the passing generations profitably is to establish a special department for encouraging the disclosure of unpatentable information, particularly regarding skill study; a department in the patent office should operate on the lines of a modern suggestion system in a motion study laboratory, with all the refinements of the present patent office, and subject to nearly all the same general principles and laws. This would furnish incentive, encouragement, and recognition, as well as a market for ideas pertaining to skill and to methods thought for the time being to represent the One Best Way to do work. Awards for disclosing full information regarding new and useful improvements in skill, which are not patentable, should be paid to the "Inventor" instead of requiring the "Inventor" to pay a fee, as is the custom in all patent offices, when he acquires exclusive rights to make and sell his invention for a term of years. Such a department could not be properly organized by anyone who does not know that the One Best Way means the best way at present obtainable. Nor could it be properly maintained by anyone who persists in believing that the individual differences in any one group of properly placed workers, due to heredity, are as great as their differences due to habit, education, wrong teaching, and automaticity.

It is to be expected that there will be a large number of people who will say that any such arrangement could not possibly work out in actual practice. Our answer is that it is already working in several very large organizations with such remarkable results that we venture to predict that a nation could afford to install it and could look for great benefits, even though it were muddled.

Time Study

Time study is the art of determining "how long it takes to do work", or, stated in other words, "how much work can be done in a given time." Time is a variable of motion study, and correct time study is a subdivision and a by-product of micromotion study. Time study should never be confused with motion study. They are quite distinct. Neither should correct time study, which is the by-product of photographically recorded times, free from personal error, be confused with the inaccurate non-method recording stop watch time study.

Development of Motion Study and Time Study

The development of motion study and time study in their relation to each other, and to fatigue study, serves--as we have already shown--as an example not only of how much slower the methods and devices are developed than is the theory, but also of the ultimate development of methods and devices that fulfil the requirements and needs, once these are thoroughly understood. We find the practice of timing work early in the history of management. Dr. Taylor said he first received his idea of taking times from Mr. Wentworth, a teacher of his at Phillips Academy, Exeter, New Hampshire. Be this as it may, Dr. Taylor is undoubtedly, as he has been called, "The Father of Time Study." He was, undoubtedly, the first who had the idea of timing the work cycles and frequent rest periods separately, thus being able to predetermine with greater accuracy than it had hitherto been done how long it would take to do work. Time study should be used for making reasonable achievable schedules and programs, according to which all can plan. In no other way can everyone assist in making the largest outputs. Time tables are necessary for railroads for greatest service to themselves and to the public, not for speeding the trains up to the point of destruction.

In spite of the fact that Taylor had no better device than the stop watch, his idea marked a great step forward in management, the full possibilities of which are little realized due to psychological defects of presentation and to objections which have nothing to do with the merit and value of the underlying principle involved. This great step of timing the work periods and the rest periods, separately is the feature that distinguishes Taylor's plan of timing for prophesying how long it would take to do work from all the work of his predecessors. It is still so important that many great engineers continue to confuse time study with motion study, although the two are entirely different and even Dr. Taylor's theory must not be confused with his practice. The two must be analyzed and criticized separately.