

HENRY GANTT

Henry Laurance Gantt, engineer, author, and consultant, was born in 1861 and died in 1919. He was educated at the Johns Hopkins University and Stevens Institute of Technology, receiving his degree in mechanical engineering from the latter institution in 1884.

Gantt worked with Taylor for many years and generally held the same views as did Taylor except that Gantt gave more attention to the man who was performing the work than to just the work itself. He was more aware of the human element in the increase of productivity than Taylor seems to have been.

In 1902 he opened an office as a scientific management consultant and concentrated on the establishment of bonus systems although he was also responsible for the reorganization of many plants. He is widely known even today for his development of the "Gantt Chart" which is a technique for graphically representing work to be done and work already accomplished. This chart evolved from his work for the U.S. Government during World War I.

Gantt's paper on "A Bonus System" is presented herein. His later writings reflected his concern with the human element, as indicated by the first part of his 1908 paper which is also included.

A Bonus System for Rewarding Labor

The system described in this paper has recently been introduced by the writer into the large machine shop of the Bethlehem Steel Company, and has met with such unqualified success that a description of it would seem to be of interest to the Society.

Aim of System. It is an attempt at harmonizing the interests of the employer and employee, and, while it affords substantial justice to the employee, requires that he shall always conform to the best interests of his employer. That it accomplishes such a result, at least in a measure, is shown by the fact that it has caused a complete change in the whole atmosphere of a shop, notwithstanding the fact that it has been in operation for a few months only.

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Description of System. A card is made out, showing in detail the best method (so far as our present knowledge goes on the subject) of performing each of the elementary operations on any piece of work, specifying the tools to be used, and setting the time needed for each of these operations as determined by experiments. The sum of these times is the total time needed to complete the piece of work. If the man follows his instructions, and accomplishes all the work laid out for him, as constituting his proper task for the day, he is paid a definite bonus in addition to the day rate which he always gets: If, however, at the end of the day, he has failed to accomplish all of the work laid out, he does not get his bonus, but simply his day rate. As the time for each detail operation is stated on the instruction card, the workman can see continually whether he is earning his bonus or not, and if he finds any operation which cannot be done in the time set, he must at once report it to his foreman. If, on careful investigation by the man making out the card, the workman's statement is found to be correct--that a portion of the task can not be done in the time stated on the card--a new instruction card is made out, explaining the proper method of working, and allowing the proper time. It is of the greatest possible importance for the moral effect upon the men that errors in making out instruction cards should be as few as possible. A man must be allowed time only for what is stated on his card, and while a reasonable time must be allowed for each operation, he should fail to receive his bonus if time is lost from any cause whatever. (The foremen also receive, in addition to their day wages, compensation proportional to the number of their men who earn a bonus, and an extra compensation if all of their men earn their bonuses.)

As these cards are made out by a skilful man, with the records at hand, they invariably prescribe a better method for doing the work than the ordinary workman or foreman could devise on the spur of the moment. As all the appliances and instructions necessary for doing the work are furnished, and a fixed premium or bonus is allowed the workman in addition to his regular rate if the work is done satisfactorily in the time set, it will be seen at once that this method is really a system of education, with prizes for those who learn, and the results already obtained bear out this idea of education most fully, for under it men have learned more in a few months than they ever did before in years.

A Differential System. A careful consideration of this system will show that, while it is not a system of piece work, it has many of the advantages of differential piece work, by which I mean that the compensation is quite large for the maximum amount of work obtainable, and quite small for anything less than this amount. For instance, if a man does all that is asked of him, which must always be possible, he gets a large extra reward; but he gets no reward, except his ordinary day rate, if he falls short of this amount. The extra bonus which the bosses earn when all of their men perform the maximum amount of work is a strong inducement to make them teach their inferior men.

Breakdowns. Again, as it is impossible for the men to earn their bonuses when their machines are out of order, it furnishes an automatic punishment for the breakdowns, for the man not only loses his bonus on the day the machine breaks down, but on all subsequent days until the machine is running satisfactorily again.

Basis of System. This system is, so far as the writer is aware, a new one, but is based on the principles of Mr. Fred. W. Taylor's system of elementary rate fixing (see paper No. 647, "A Piece Rate System, Transactions, vol. xvi, p. 856), and is as far as possible removed from the old fashioned method of fixing piece rates from records of the total time it has taken to do a job. It possesses an advantage over direct piece work in that it is more flexible and can be introduced with greater ease and under conditions where piece work proper would be impossible. When it is realized that proper piece work will, in many cases, produce at least three or four times as large an output as ordinary day work, the difficulties of putting directly on piece work men who have been accustomed to doing work in their own way and in their own time would seem to be, and generally is, extremely difficult. While the men who are on day work usually realize that they are not doing all they can do, when they are told that it is possible to do three or four times as much as they are doing they simply do not believe it, and it is very difficult to make them accept as just a piece rate founded on this basis; but a reward in addition to their day rate constantly held before them will finally be striven for by some one, and when one has obtained it others will try for it. In other words, if the instruction card is made out and a substantial bonus offered, time will do the rest.

Scientific Method. In order to get the information necessary to fix proper piece rates, or even to make out good instruction cards, a very large amount of detail work is necessary. When we realize, however, that any operation, no matter how complicated, can be resolved into a series of simple operations, we have grasped the key to the solution of many problems. Further study leads us to the conclusion that many complicated operations are composed of a number of the same simple operations performed in a different order, and frequently that the number of elementary operations is smaller than the number of complicated operations of which they form the parts. The logical method, therefore, of studying a complicated operation is undoubtedly to study the simple operations of which it is composed, a thorough knowledge of which will always throw a great deal of light on the complex operation. In other words, the time needed for performing any complex operation must necessarily depend upon the time and method of performing the simple operations of which it is composed. The natural method, then, of

informing ourselves about a complex operation is to study its component elementary operations. Such study divides itself into three parts, as follows:

- An analysis of the operation into its elements.
- A study of these elements separately.
- A synthesis, or putting together the results of our study.

This is recognized at once as simply the ordinary scientific method of procedure when it is desired to make any kind of an investigation, and it is well known to all that until this method was known and adopted science made practically no progress, and the writer believes that if it is desired to obtain the correct solution of any problem we must follow the well-beaten paths of scientific investigation, which alone have led to reliable results. The ordinary man, whether mechanic or laborer, if let to himself, seldom performs any operation in the manner most economical, either of time or labor, and it has been conclusively proven that even on ordinary day work a very decided advantage can be gained by giving the men instructions as to how to perform the work they are set to do, and, when these instructions are the result of scientific investigation, the gain in efficiency is usually beyond our highest expectations.

It is perfectly well known that nearly every operation can be, and in actual work is, performed in a number of different ways; but it is self-evident that all of these ways are not equally efficient, when we consider that the object to be attained is to accomplish the greatest amount of work in the shortest time, and with as little expenditure of energy as is consistent with quickest work. As a rule, some of the methods employed are so obviously inefficient that they may be discarded at once, but it is often a problem of considerable difficulty to find out the very best method, and it is only by a scientific investigation of all the elements of the operation that we can hope to arrive at even an approximate solution of the problem. ...

Training Workmen in Habits of Industry and Cooperation

The widespread interest in the training of workmen which has been so marked for several years is due to the evident need for better methods of training than those now generally in vogue.

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The one point in which these methods as a class seem to be lacking is that they do not lay enough stress on the fact that workmen must have industry as well as knowledge and skill.

Habits of industry are far more valuable than any kind of knowledge or skill, for with such habits as a basis, the problem of acquiring knowledge and skill is much simplified. Without industry, knowledge and skill are of little value, and sometimes a great detriment.

If workmen are systematically trained in habits of industry, it has been found possible, not only to train many of them to be efficient in whatever capacity they are needed, but to develop an effective system of cooperation between workmen and foreman.

This is not a theory, but the record of a fact.

It is too much to hope, however, that the methods about to be described will be adopted extensively in the near future, for the great majority of managers, whose success is based mainly on their personal ability, will hesitate before adopting what seems to them the slower and less forceful policy of studying problems and training workmen; but should they do so they will have absolutely no desire to return to their former methods.

The general policy of the past has been to drive, but the era of force must give way to that of knowledge, and the policy of the future will be to teach and to lead, to the advantage of all concerned. The vision of workmen in general eager to cooperate in carrying out the results of scientific investigations must be dismissed as a dream of the millennium, but results so far accomplished indicate that nothing will do more to bring about that millennium than training workmen in habits of industry and cooperation. A study of the principles on which such training has been successfully established will convince the most skeptical that if they are carried out good results must follow. An outline of these principles has already been submitted to the Society in a paper entitled "A Bonus System of Rewarding Labor."¹

Under this system each man has his work assigned to him in the form of a task to be done by a prescribed method with definite appliances and to be completed within a certain time. The task is based on a detailed investigation by a trained expert of the best methods of doing the work; and the task setter, or his assistant, acts as an instructor to teach the workmen to do the work in the manner and time specified. If the work is done within the time allowed by the expert, and is up to the standard for quality, the workman receives extra compensation in addition to his day's pay only.

¹ A Bonus system of Rewarding Labor, December 1901, a system of task work with a bonus which had recently been introduced by the writer into the large machine shop of the Bethlehem Steel Company, as a part of the system of management being introduced into their works by F.W. Taylor. (See previous paper--Ed.)

This system, in connection with the other work of Mr. F. W. Taylor, so greatly increased the output and reduced the cost of the work in the large machine shop of the Bethlehem Steel Company that for the past seven years the writer has given a large portion of his time to the development of its possibilities. The results have far exceeded his expectations.

In his closing remarks on the above paper, the writer emphasized the value of the system as a means of training workmen; and the late Dr. Robert H. Thurston* in his discussion of it was so optimistic as to the results it would produce on "workmen and foremen and employer alike" that the writer felt that his enthusiasm over a new and promising method had carried him, perhaps, a little too far. Results have fully justified Dr. Thurston's predictions, however, for today the method has been developed as a practical system of education and training for all, from the highest to the lowest. The fact, so repeatedly emphasized by Mr. Taylor, that tasks should be set only as the result of a scientific investigation, has proved of an educational value hardly to be over-estimated, for the scientific investigation of a process that has been developed without the assistance of science almost always reveals inconsistencies which it is possible to eliminate, thus perfecting the process and at the same time reducing its cost.

It is this scientific investigation that points to improvement in methods and educates owners and managers; but the average workman is interested only in his daily wage and has no special desire to learn improved methods. The results of our investigations are of little practical value, therefore, unless we can first teach our workmen how to use them, and then can induce them to do as they are taught.

Practical Application

For this purpose an instructor, a task and a bonus have been found most useful. People as a rule prefer to work at the speed and in the manner to which they have been accustomed, but are usually willing to work at any reasonable speed and in any reasonable manner, if sufficient inducement is offered for so doing, and if they are so trained as to be able to earn the reward. In carrying out this plan we try to find men who are already skilled and able to perform the task set. It frequently happens, however, that the number of such men is insufficient and it takes time to train the unskilled to a proper degree of efficiency; but with a bonus as an incentive, and a proper instructor, a very fair proportion of the unskilled finally succeed in performing a task that was at first entirely beyond them.

*Robert Henry Thurston, 1839-1903. American engineer and educator. Founder and first president of A.S.M.E.--Editor

Unskilled workmen, who under these conditions have become skilled in one kind of work, readily learn another, and soon begin to realize that they can, in a measure at least, make up for their loss in not having learned a trade.

As they become more skilled, they form better habits of work, lose less time and become more reliable. Their health improves, and the improvement in their general appearance is very marked. This improvement in health seems to be due to a more regular and active life, combined with a greater interest in their work, for it is a well known fact that work in which we are interested and which holds our attention without any effort on our part, tires us much less than that we have to force ourselves to do. The task with a reward for its accomplishment produces this interest and holds the attention, with the invariable results of more work, better work and better satisfied workers.

The Task and Bonus method of training not only furnishes the workman with the required knowledge, but by offering an inducement to utilize that knowledge properly, trains him in proper habits of work.

Habits of Work

In all work both quantity and quality must be considered, and our task method demands a maximum quantity, all of which must be up to the standard for quality. Workmen trained under this method acquire the habit of doing a large amount of work well, and disprove the oft-repeated fallacy that good work must be done slowly. As a matter of fact, our quickest workers almost always do the best work when following instructions. We set great store by the habit of working quickly, for no matter how much skill a workman may have, he will not attain the best success without quickness as well.

Habits of work in a mechanic are comparable with habits of thought in an engineer, and our industrial schools should make proper habits of work the basis on which to build their training in manual dexterity. The engineering school does not make engineers, but tries to furnish its graduates with an equipment that will enable them to utilize readily and rapidly their own experience and that of others. In the same manner, industrial training schools should equip their graduates with habits of industry that will make them as mechanics capable, and willing to do a large amount of good work.

As the writer sees it, one of the most valuable assets that the graduate of a technical college or an industrial school can have is the habit of doing promptly and to the best of his ability the work set before him. With this habit and reasonable intelligence he can make good progress. This habit is one of the first results of the Task and Bonus system, for it is a noticeable fact that task workers form habits of industry which they maintain when on day's work with no bonus in sight.

In all schemes for technical or industrial education or training that the writer has seen, emphasis has been laid on the importance of knowing how. The writer wishes to add that ability and willingness to do are of at least equal importance. Many skilled workmen make their skill an excuse for slow work. Those that have not been trained to utilize efficiently what they have learned never attain the success that should be theirs.

Under our task system the workman is taught how and trained to do at the same time. Knowing and doing are thus closely associated in his mind, and it is our experience that the habit of doing efficiently what is laid out for him becomes so fixed that he performs without hesitation tasks at which a man not trained to follow instructions would absolutely fail. This is exactly what should be expected and means nothing more than that in our industrial army the workman who has gained confidence in his superior follows his orders without hesitation, just as the private soldier follows the orders of his officer even though he does not see where they lead.

This is not a fanciful comparison, for I have known more than one case in which a workman expressed his doubts as to the possibility of doing a task, and on getting the reply that the task was all right, said, "If you say it can be done, I will do it."

Workers who have been unable to perform their tasks in the time set have frequently asked to have an instructor stand by them with a stop-watch to time the detail operations and show them just where-in they failed, with the result that they soon learned to earn their bonus regularly.

The first essential for a workman to become successful under our task system is to obey orders, and having acquired this habit he soon finds out that a skilled investigator can learn more about doing a piece of work than he knows "off hand." Having satisfied himself on this point, he goes to work at the tasks set him with the determination to earn his bonus, with the result, if he has the natural ability, that he soon becomes a rapid and skillful workman.

Learning to obey orders is often the hardest part of the workman's task, for a large percentage of men seem so constituted as to be apparently unable to do as they are told. As a rule, however, this is a feature of a certain stage of their development only, which under proper conditions they overcome at a later date. For instance, many very capable men who were impatient of restraint when they should have learned a trade, find themselves at the age of twenty-five or less in the class of

unskilled workmen, although their ability would have enabled them to do well at almost any trade. It is this class of men, when they have come to realize the difference between a skilled workman and one not skilled, that furnishes us with many of our best task workers. Such men often see in our instructor, task, and bonus a chance to redeem some of their earlier errors, and by learning thoroughly how to do, and doing one thing after another, in the best way that can be devised, get a training, in a short time, that does much to make up for the previous neglect of their opportunities.