

# *The Principles of Scientific Management*

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## INTRODUCTION

**P**RESIDENT ROOSEVELT, in his address to the Governors at the White House, prophetically remarked that "The conservation of our national resources is only preliminary to the larger question of national efficiency."

The whole country at once recognized the importance of conserving our material resources and a large movement has been started which will be effective in accomplishing this object. As yet, however, we have but vaguely appreciated the importance of "the larger question of increasing our national efficiency."

We can see our forests vanishing, our water-powers going to waste, our soil being carried by floods into the sea; and the end of our coal and our iron is in sight. But our larger wastes of human effort, which go on every day through such of our acts as are blundering, ill-directed, or inefficient, and which Mr. Roosevelt refers to as a lack of "national efficiency," are less visible, less tangible, and are but vaguely appreciated.

We can see and feel the waste of material things. Awkward, inefficient, or ill-directed movements of men, however, leave nothing visible or tangible behind them. Their appreciation calls for an act

of memory, an effort of the imagination. And for this reason, even though our daily loss from this source is greater than from our waste of material things, the one has stirred us deeply, while the other has moved us but little.

As yet there has been no public agitation for "greater national efficiency," no meetings have been called to consider how this is to be brought about. And still there are signs that the need for greater efficiency is widely felt.

The search for better, for more competent men, from the presidents of our great companies down to our household servants, was never more vigorous than it is now. And more than ever before is the demand for competent men in excess of the supply.

What we are all looking for, however, is the ready-made, competent man; the man whom some one else has trained. It is only when we fully realize that our duty, as well as our opportunity, lies in systematically cooperating to train and to make this competent man, instead of in hunting for a man whom some one else has trained, that we shall be on the road to national efficiency.

In the past the prevailing idea has been well expressed in the saying that "Captains of industry are born, not made"; and the theory has been that if one could get the right man, methods could be safely left to him. In the future it will be appreciated that our leaders must be trained right as well as born right, and that no great man can (with the old system of personal management) hope to com-

pete with a number of ordinary men who have been properly organized so as efficiently to cooperate.

In the past the man has been first; in the future the system must be first. This in no sense, however, implies that great men are not needed. On the contrary, the first object of any good system must be that of developing first-class men; and under systematic management the best man rises to the top more certainly and more rapidly than ever before.

This paper has been written:

*First.* To point out, through a series of simple illustrations, the great loss which the whole country is suffering through inefficiency in almost all of our daily acts.

*Second.* To try to convince the reader that the remedy for this inefficiency lies in systematic management, rather than in searching for some unusual or extraordinary man.

*Third.* To prove that the best management is a true science, resting upon clearly defined laws, rules, and principles, as a foundation. And further to show that the fundamental principles of scientific management are applicable to all kinds of human activities, from our simplest individual acts to the work of our great corporations, which call for the most elaborate cooperation. And, briefly, through a series of illustrations, to convince the reader that whenever these principles are correctly applied, results must follow which are truly astounding.

This paper was originally prepared for presenta-

tion to The American Society of Mechanical Engineers. The illustrations chosen are such as, it is believed, will especially appeal to engineers and to managers of industrial and manufacturing establishments, and also quite as much to all of the men who are working in these establishments. It is hoped, however, that it will be clear to other readers that the same principles can be applied with equal force to all social activities: to the management of our homes; the management of our farms; the management of the business of our tradesmen, large and small; of our churches, our philanthropic institutions, our universities, and our governmental departments.

# *The Principles of Scientific Management*

## CHAPTER I

### FUNDAMENTALS OF SCIENTIFIC MANAGEMENT

**T**HE principal object of management should be to secure the maximum prosperity for the employer, coupled with the maximum prosperity for each employé.

The words "maximum prosperity" are used, in their broad sense, to mean not only large dividends for the company or owner, but the development of every branch of the business to its highest state of excellence, so that the prosperity may be permanent.

In the same way maximum prosperity for each employé means not only higher wages than are usually received by men of his class, but, of more importance still, it also means the development of each man to his state of maximum efficiency, so that he may be able to do, generally speaking, the highest grade of work for which his natural abilities fit him, and it further means giving him, when possible, this class of work to do.

It would seem to be so self-evident that maxi-

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mum prosperity for the employer, coupled with maximum prosperity for the employé, ought to be the two leading objects of management, that even to state this fact should be unnecessary. And yet there is no question that, throughout the industrial world, a large part of the organization of employers, as well as employés, is for war rather than for peace, and that perhaps the majority on either side do not believe that it is possible so to arrange their mutual relations that their interests become identical.

The majority of these men believe that the fundamental interests of employés and employers are necessarily antagonistic. Scientific management, on the contrary, has for its very foundation the firm conviction that the true interests of the two are one and the same; that prosperity for the employer cannot exist through a long term of years unless it is accompanied by prosperity for the employé, and *vice versa*; and that it is possible to give the workman what he most wants — high wages — and the employer what he wants — a low labor cost — for his manufactures.

It is hoped that some at least of those who do not sympathize with each of these objects may be led to modify their views; that some employers, whose attitude toward their workmen has been that of trying to get the largest amount of work out of them for the smallest possible wages, may be led to see that a more liberal policy toward their men will pay them better; and that some of those workmen who begrudge a fair and even a large profit to their

employers, and who feel that all of the fruits of their labor should belong to them, and that those for whom they work and the capital invested in the business are entitled to little or nothing, may be led to modify these views.

No one can be found who will deny that in the case of any single individual the greatest prosperity can exist only when that individual has reached his highest state of efficiency; that is, when he is turning out his largest daily output.

The truth of this fact is also perfectly clear in the case of two men working together. To illustrate: if you and your workman have become so skilful that you and he together are making two pairs of shoes in a day, while your competitor and his workman are making only one pair, it is clear that after selling your two pairs of shoes you can pay your workman much higher wages than your competitor who produces only one pair of shoes is able to pay his man, and that there will still be enough money left over for you to have a larger profit than your competitor.

In the case of a more complicated manufacturing establishment, it should also be perfectly clear that the greatest permanent prosperity for the workman, coupled with the greatest prosperity for the employer, can be brought about only when the work of the establishment is done with the smallest combined expenditure of human effort, plus nature's resources, plus the cost for the use of capital in the shape of machines, buildings, etc. Or, to state the same



thing in a different way: that the greatest prosperity can exist only as the result of the greatest possible productivity of the men and machines of the establishment — that is, when each man and each machine are turning out the largest possible output; because unless your men and your machines are daily turning out more work than others around you, it is clear that competition will prevent your paying higher wages to your workmen than are paid to those of your competitor. And what is true as to the possibility of paying high wages in the case of two companies competing close beside one another is also true as to whole districts of the country and even as to nations which are in competition. In a word, that maximum prosperity can exist only as the result of maximum productivity. Later in this paper illustrations will be given of several companies which are earning large dividends and at the same time paying from 30 per cent. to 100 per cent. higher wages to their men than are paid to similar men immediately around them, and with whose employers they are in competition. These illustrations will cover different types of work, from the most elementary to the most complicated.

{ If the above reasoning is correct, it follows that the most important object of both the workmen and the management should be the training and development of each individual in the establishment, so that he can do (at his fastest pace and with the maximum of efficiency) the highest class of work for which his natural abilities fit him.

These principles appear to be so self-evident that many men may think it almost childish to state them. Let us, however, turn to the facts, as they actually exist in this country and in England. The English and American peoples are the greatest sportsmen in the world. Whenever an American workman plays baseball, or an English workman plays cricket, it is safe to say that he strains every nerve to secure victory for his side. He does his very best to make the largest possible number of runs. [The universal sentiment is so strong that any man who fails to give out all there is in him in sport is branded as a "quitter," and treated with contempt by those who are around him.

When the same workman returns to work on the following day, instead of using every effort to turn out the largest possible amount of work, in a majority of the cases this man deliberately plans to do as little as he safely can — to turn out far less work than he is well able to do — in many instances to do not more than one-third to one-half of a proper day's work. And in fact if he were to do his best to turn out his largest possible day's work, he would be abused by his fellow-workers for so doing, even more than if he had proved himself a "quitter" in sport. Underworking, that is, deliberately working slowly so as to avoid doing a full day's work, "soldiering," as it is called in this country, "hanging it out," as it is called in England, "ca canae," as it is called in Scotland, is almost universal in industrial establishments, and prevails also to a

large extent in the building trades; and the writer asserts without fear of contradiction that this constitutes the greatest evil with which the working-people of both England and America are now afflicted.

It will be shown later in this paper that doing away with slow working and "soldiering" in all its forms and so arranging the relations between employer and employé that each workman will work to his very best advantage and at his best speed, accompanied by the intimate cooperation with the management and the help (which the workman should receive) from the management, would result on the average in nearly doubling the output of each man, and each machine. What other reforms, among those which are being discussed by these two nations, could do as much toward promoting prosperity, toward the diminution of poverty, and the alleviation of suffering? America and England have been recently agitated over such subjects as the tariff, the control of the large corporations on the one hand, and of hereditary power on the other hand, and over various more or less socialistic proposals for taxation, etc. On these subjects both peoples have been profoundly stirred, and yet hardly a voice has been raised to call attention to this vastly greater and more important subject of "soldiering," which directly and powerfully affects the wages, the prosperity, and the life of almost every working-man, and also quite as much the prosperity of every industrial establishment in the nation.

The elimination of "soldiering" and of the several causes of slow working would so lower the cost of production that both our home and foreign markets would be greatly enlarged, and we could compete on more than even terms with our rivals. It would remove one of the fundamental causes for dull times, for lack of employment, and for poverty, and therefore would have a more permanent and far-reaching effect upon these misfortunes than any of the curative remedies that are now being used to soften their consequences. It would insure higher wages and make shorter working hours and better working and home conditions possible. *over-production*

Why is it, then, in the face of the self-evident fact that maximum prosperity can exist only as the result of the determined effort of each workman to turn out each day his largest possible day's work, that the great majority of our men are deliberately doing just the opposite, and that even when the men have the best of intentions their work is in most cases far from efficient?

There are three causes for this condition, which may be briefly summarized as:

*First.* The fallacy, which has from time immemorial been almost universal among workmen, that a material increase in the output of each man or each machine in the trade would result in the end in throwing a large number of men out of work.

*Second.* The defective systems of management which are in common use, and which make it necessary for each workman to soldier, or work slowly,

in order that he may protect his own best interests.

*Third.* The inefficient rule-of-thumb methods, which are still almost universal in all trades, and in practising which our workmen waste a large part of their effort.

This paper will attempt to show the enormous gains which would result from the substitution by our workmen of scientific for rule-of-thumb methods.

To explain a little more fully these three causes:

*First.* The great majority of workmen still believe that if they were to work at their best speed they would be doing a great injustice to the whole trade by throwing a lot of men out of work, and yet the history of the development of each trade shows that each improvement, whether it be the invention of a new machine or the introduction of a better method, which results in increasing the productive capacity of the men in the trade and cheapening the costs, instead of throwing men out of work make in the end work for more men.

The cheapening of any article in common use almost immediately results in a largely increased demand for that article. Take the case of shoes, for instance. The introduction of machinery for doing every element of the work which was formerly done by hand has resulted in making shoes at a fraction of their former labor cost, and in selling them so cheap that now almost every man, woman, and child in the working-classes buys one or two pairs of shoes per year, and wears shoes all the time,

whereas formerly each workman bought perhaps one pair of shoes every five years, and went barefoot most of the time, wearing shoes only as a luxury or as a matter of the sternest necessity. In spite of the enormously increased output of shoes per workman, which has come with shoe machinery, the demand for shoes has so increased that there are relatively more men working in the shoe industry now than ever before.

The workmen in almost every trade have before them an object lesson of this kind, and yet, because they are ignorant of the history of their own trade even, they still firmly believe, as their fathers did before them, that it is against their best interests for each man to turn out each day as much work as possible.

Under this fallacious idea a large proportion of the workmen of both countries each day deliberately work slowly so as to curtail the output. Almost every labor union has made, or is contemplating making, rules which have for their object curtailing the output of their members, and those men who have the greatest influence with the working-people, the labor leaders as well as many people with philanthropic feelings who are helping them, are daily spreading this fallacy and at the same time telling them that they are overworked.

A great deal has been and is being constantly said about "sweat-shop" work and conditions. The writer has great sympathy with those who are overworked, but on the whole a greater sympathy for

those who are *under paid*. For every individual, however, who is overworked, there are a hundred who intentionally underwork — greatly underwork — every day of their lives, and who for this reason deliberately aid in establishing those conditions which in the end inevitably result in low wages. And yet hardly a single voice is being raised in an endeavor to correct this evil.

As engineers and managers, we are more intimately acquainted with these facts than any other class in the community, and are therefore best fitted to lead in a movement to combat this fallacious idea by educating not only the workmen but the whole of the country as to the true facts. And yet we are practically doing nothing in this direction, and are leaving this field entirely in the hands of the labor agitators (many of whom are misinformed and misguided), and of sentimentalists who are ignorant as to actual working conditions.

*Second.* As to the second cause for soldiering — the relations which exist between employers and employés under almost all of the systems of management which are in common use — it is impossible in a few words to make it clear to one not familiar with this problem why it is that the *ignorance of employers* as to the proper time in which work of various kinds should be done makes it for the interest of the workman to “soldier.”

The writer therefore quotes herewith from a paper read before The American Society of Mechanical Engineers, in June, 1903, entitled “Shop Man-

agement," which it is hoped will explain fully this cause for soldiering:

"This loafing or soldiering proceeds from two causes. First, from the natural instinct and tendency of men to take it easy, which may be called natural soldiering. Second, from more intricate second thought and reasoning caused by their relations with other men, which may be called systematic soldiering.

"There is no question that the tendency of the average man (in all walks of life) is toward working at a slow, easy gait, and that it is only after a good deal of thought and observation on his part or as a result of example, conscience, or external pressure that he takes a more rapid pace.

"There are, of course, men of unusual energy, vitality, and ambition who naturally choose the fastest gait, who set up their own standards, and who work hard, even though it may be against their best interests. But these few uncommon men only serve by forming a contrast to emphasize the tendency of the average.

"This common tendency to 'take it easy' is greatly increased by bringing a number of men together on similar work and at a uniform standard rate of pay by the day.

"Under this plan the better men gradually but surely slow down their gait to that of the poorest and least efficient. When a naturally energetic man works for a few days beside a lazy one, the logic of the situation is unanswerable.



‘Why should I work hard when that lazy fellow gets the same pay that I do and does only half as much work?’

“A careful time study of men working under these conditions will disclose facts which are ludicrous as well as pitiable.

“To illustrate: The writer has timed a naturally energetic workman who, while going and coming from work, would walk at a speed of from three to four miles per hour, and not infrequently trot home after a day’s work. On arriving at his work he would immediately slow down to a speed of about one mile an hour. When, for example, wheeling a loaded wheelbarrow, he would go at a good fast pace even up hill in order to be as short a time as possible under load, and immediately on the return walk slow down to a mile an hour, improving every opportunity for delay short of actually sitting down. In order to be sure not to do more than his lazy neighbor, he would actually tire himself in his effort to go slow.

“These men were working under a foreman of good reputation and highly thought of by his employer, who, when his attention was called to this state of things, answered: ‘Well, I can keep them from sitting down, but the devil can’t make them get a move on while they are at work.’

“The natural laziness of men is serious, but by far the greatest evil from which both workmen and employers are suffering is the *systematic soldiering* which is almost universal under all of the ordinary

schemes of management and which results from a careful study on the part of the workmen of what will promote their best interests. \*

"The writer was much interested recently in hearing one small but experienced golf caddy boy of twelve explaining to a green caddy, who had shown special energy and interest, the necessity of going slow and lagging behind his man when he came up to the ball, showing him that since they were paid by the hour, the faster they went the less money they got, and finally telling him that if he went too fast the other boys would give him a licking.

"This represents a type of *systematic soldiering* which is not, however, very serious, since it is done with the knowledge of the employer, who can quite easily break it up if he wishes.

"The greater part of the *systematic soldiering*, however, is done by the men with the deliberate object of keeping their employers ignorant of how fast work can be done.

"So universal is soldiering for this purpose that hardly a competent workman can be found in a large establishment, whether he works by the day or on piece work, contract work, or under any of the ordinary systems, who does not devote a considerable part of his time to studying just how slow he can work and still convince his employer that he is going at a good pace.

"The causes for this are, briefly, that practically all employers determine upon a maximum sum which they feel it is right for each of their classes

of employees to earn per day, whether their men work by the day or piece.

"Each workman soon finds out about what this figure is for his particular case, and he also realizes that when his employer is convinced that a man is capable of doing more work than he has done, he will find sooner or later some way of compelling him to do it with little or no increase of pay.

"Employers derive their knowledge of how much of a given class of work can be done in a day from either their own experience, which has frequently grown hazy with age, from casual and unsystematic observation of their men, or at best from records which are kept, showing the quickest time in which each job has been done. In many cases the employer will feel almost certain that a given job can be done faster than it has been, but he rarely cares to take the drastic measures necessary to force men to do it in the quickest time, unless he has an actual record proving conclusively how fast the work can be done.

"It evidently becomes for each man's interest, then, to see that no job is done faster than it has been in the past. The younger and less experienced men are taught this by their elders, and all possible persuasion and social pressure is brought to bear upon the greedy and selfish men to keep them from making new records which result in temporarily increasing their wages, while all those who come after them are made to work harder for the same old pay.

"Under the best day work of the ordinary type,

when accurate records are kept of the amount of work done by each man and of his efficiency, and when each man's wages are raised as he improves, and those who fail to rise to a certain standard are discharged and a fresh supply of carefully selected men are given work in their places, both the natural loafing and systematic soldiering can be largely broken up. This can only be done, however, when the men are thoroughly convinced that there is no intention of establishing piece work even in the remote future, and it is next to impossible to make men believe this when the work is of such a nature that they believe piece work to be practicable. In most cases their fear of making a record which will be used as a basis for piece work will cause them to soldier as much as they dare.

"It is, however, under piece work that the art of systematic soldiering is thoroughly developed; after a workman has had the price per piece of the work he is doing lowered two or three times as a result of his having worked harder and increased his output, he is likely entirely to lose sight of his employer's side of the case and become imbued with a grim determination to have no more cuts if soldiering can prevent it. Unfortunately for the character of the workman, soldiering involves a deliberate attempt to mislead and deceive his employer, and thus upright and straightforward workmen are compelled to become more or less hypocritical. The employer is soon looked upon as an antagonist, if not an enemy, and the mutual confidence which

should exist between a leader and his men, the enthusiasm, the feeling that they are all working for the same end and will share in the results is entirely lacking.

"The feeling of antagonism under the ordinary piece-work system becomes in many cases so marked on the part of the men that any proposition made by their employers, however reasonable, is looked upon with suspicion, and soldiering becomes such a fixed habit that men will frequently take pains to restrict the product of machines which they are running when even a large increase in output would involve no more work on their part."

*Third.* As to the third cause for slow work, considerable space will later in this paper be devoted to illustrating the great gain, both to employers and employés, which results from the substitution of scientific for rule-of-thumb methods in even the smallest details of the work of every trade. The enormous saving of time and therefore increase in the output which it is possible to effect through eliminating unnecessary motions and substituting fast for slow and inefficient motions for the men working in any of our trades can be fully realized only after one has personally seen the improvement which results from a thorough motion and time study, made by a competent man.

To explain briefly: owing to the fact that the workmen in all of our trades have been taught the details of their work by observation of those immediately around them, there are many different ways in

common use for doing the same thing, perhaps forty, fifty, or a hundred ways of doing each act in each trade, and for the same reason there is a great variety in the implements used for each class of work. Now, among the various methods and implements used in each element of each trade there is always one method and one implement which is quicker and better than any of the rest. And this one best method and best implement can only be discovered or developed through a scientific study and analysis of all of the methods and implements in use, together with accurate, minute, motion and time study. This involves the gradual substitution of science for rule of thumb throughout the mechanic arts.

This paper will show that the underlying philosophy of all of the old systems of management in common use makes it imperative that each workman shall be left with the final responsibility for doing his job practically as he thinks best, with comparatively little help and advice from the management. And it will also show that because of this isolation of workmen, it is in most cases impossible for the men working under these systems to do their work in accordance with the rules and laws of a science or art, even where one exists.

The writer asserts as a general principle (and he proposes to give illustrations tending to prove the fact later in this paper) that in almost all of the mechanic arts the science which underlies each act of each workman is so great and amounts to so much

that the workman who is best suited to actually doing the work is incapable of fully understanding this science, without the guidance and help of those who are working with him or over him, either through lack of education or through insufficient mental capacity. In order that the work may be done in accordance with scientific laws, it is necessary that there shall be a far more equal division of the responsibility between the management and the workmen than exists under any of the ordinary types of management. Those in the management whose duty it is to develop this science should also guide and help the workman in working under it, and should assume a much larger share of the responsibility for results than under usual conditions is assumed by the management.

The body of this paper will make it clear that, to work according to scientific laws, the management must take over and perform much of the work which is now left to the men; almost every act of the workman should be preceded by one or more preparatory acts of the management which enable him to do his work better and quicker than he otherwise could. And each man should daily be taught by and receive the most friendly help from those who are over him, instead of being, at the one extreme, driven or coerced by his bosses, and at the other left to his own unaided devices.

{ This close, intimate, personal cooperation between the management and the men is of the essence of modern scientific or task management.

It will be shown by a series of practical illustrations that, through this friendly cooperation, namely, through sharing equally in every day's burden, all of the great obstacles (above described) to obtaining the maximum output for each man and each machine in the establishment are swept away. The 30 per cent. to 100 per cent. increase in wages which the workmen are able to earn beyond what they receive under the old type of management, coupled with the daily intimate shoulder to shoulder contact with the management, entirely removes all cause for soldiering. And in a few years, under this system, the workmen have before them the object lesson of seeing that a great increase in the output per man results in giving employment to more men, instead of throwing men out of work, thus completely eradicating the fallacy that a larger output for each man will throw other men out of work.

It is the writer's judgment, then, that while much can be done and should be done by writing and talking toward educating not only workmen, but all classes in the community, as to the importance of obtaining the maximum output of each man and each machine, it is only through the adoption of modern scientific management that this great problem can be finally solved. Probably most of the readers of this paper will say that all of this is mere theory. On the contrary, the theory, or philosophy, of scientific management is just beginning to be understood, whereas the management itself has been a gradual evolution, extending over a period



of nearly thirty years. And during this time the employes of one company after another, including a large range and diversity of industries, have gradually changed from the ordinary to the scientific type of management. At least 50,000 workmen in the United States are now employed under this system; and they are receiving from 30 per cent. to 100 per cent. higher wages daily than are paid to men of similar caliber with whom they are surrounded, while the companies employing them are more prosperous than ever before. In these companies the output, per man and per machine, has on an average been doubled. During all these years there has never been a single strike among the men working under this system. In place of the suspicious watchfulness and the more or less open warfare which characterizes the ordinary types of management, there is universally friendly cooperation between the management and the men.

Several papers have been written, describing the expedients which have been adopted and the details which have been developed under scientific management and the steps to be taken in changing from the ordinary to the scientific type. But unfortunately most of the readers of these papers have mistaken the mechanism for the true essence. Scientific management fundamentally consists of certain broad general principles, a certain philosophy, which can be applied in many ways, and a description of what any one man or men may believe to be the best mechanism for applying these general principles

should in no way be confused with the principles themselves.

It is not here claimed that any single panacea exists for all of the troubles of the working-people or of employers. As long as some people are born lazy or inefficient, and others are born greedy and brutal, as long as vice and crime are with us, just so long will a certain amount of poverty, misery, and unhappiness be with us also. No system of management, no single expedient within the control of any man or any set of men can insure continuous prosperity to either workmen or employers. Prosperity depends upon so many factors entirely beyond the control of any one set of men, any state, or even any one country, that certain periods will inevitably come when both sides must suffer, more or less. It is claimed, however, that under scientific management the intermediate periods will be far more prosperous, far happier, and more free from discord and dissension. And also, that the periods will be fewer, shorter and the suffering less. And this will be particularly true in any one town, any one section of the country, or any one state which first substitutes the principles of scientific management for the rule of thumb.

That these principles are certain to come into general use practically throughout the civilized world, sooner or later, the writer is profoundly convinced, and the sooner they come the better for all the people.