

# **Psychological Factors Affecting Mechanized Mining Efficiency**

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MECHANIZATION of American coal mining has made, and is still making, rapid progress. No one needs to waste time stating its merits. Economic pressure will compel the abandonment of manual methods in coal production wherever mechanization is physically possible. Economic pressure will also provide the incentive needed to insure progress in the improvement of machines and mining systems. I submit, however, that it is entirely possible to make very rapid progress along strictly technological lines and at the same time to make much slower progress in approaching maximum productivity and efficiency. As a background for what I have to say, I wish to raise the question—how efficient are our mechanized mines, and to what extent is productivity affected by the mental attitude of management and workers?

The output of any piece of mining equipment is controlled by psychological factors. The work attitude of the machine operator and the other workmen; the state of mind of the foreman and the intelligence and disposition of top management all affect production. The question is—how much? Each instance, of course, requires its own answer. In every case, however, the answer is obtainable. If the answers are not obtained and if the psychological problem is ignored, it is very likely that technical studies and mechanical alterations will fail to produce results. The machinery salesman may suggest that by discarding your present equipment and installing his machine, you can solve your production worries. Sometimes his solution works—often it doesn't. In the successful instances not infrequently the improvement is the result of an accidental correction of some psychological factor



simultaneously with the change in equipment. I am all for more and better machinery, but I have been disappointed often enough to make me careful to avoid over-simplification of my problems by attempting to reduce them all to mechanical terms.

In the manufacturing industries the effect of work attitude on production is widely recognized. Some manufacturers have made outstanding progress as a result of giving very special attention to psychological factors in production. These factors have a more marked effect on the productivity of a mechanized coal mine than they do in most manufacturing industries. This is largely the result of the fact that mechanized mining does not consist of a mere routine of pushing buttons and pulling levers. A printing press or an automatic screw machine practically does its own thinking. Very few mining machines have this capacity built into them. Constant alertness and initiative on the part of the operator are required at all times. He must be able and willing to adapt himself to a set of unpredictable conditions. His productivity depends, for the most part, upon his skill and work attitude. If he feels that he is producing too much coal, and that he is, therefore, working himself out of a job; if he thinks the Company is making too much money; if he dislikes his foreman; if his wife happened to spend three days' wages for a new hat the day before—he may have a "what's the use" attitude, resulting in a voluntary or involuntary slow-down. On some jobs, such as loading machine operator, the attitude of the workman influences not only his output, but also has a substantial effect on the men in various other related jobs. This situation is what makes it so easy for the slow-down to become chronic. On many jobs in the mine the worker's thinking may influence his productivity 50% or more. In sup-

port of this statement, the following examples are cited:

Time studies prove that the modern mounted coal cutter has more than twice the cutting capacity of the conventional shortwall machine. It is quite common to find, when shortwalls are discarded in favor of mounted machines, that two men, with a fancy cutter costing three times as much as their old shortwall, actually cut less coal—why?—usually because at the time the change in equipment was made the two machine men changed from piece work to hourly rates. On the other hand I have experienced instances where two men, with an old time shortwall, consistently got the maximum output from the machine while working under hourly rates. In this case they produced efficiently simply because someone was smart enough to make them want to do so. In many mines one of the production bottlenecks is drilling. I have seen one man, with a post-mounted electric drill, consistently average seventy-five holes per shift without over-exerting himself. I have seen mines in similar conditions, with two men operating the same type of machine, average less than sixty holes per shift—why didn't they drill more?—they didn't want to. I have seen a mine where the section tracklayers averaged laying three 40-lb. switches each, per seven-hour day, again without any undue exertion. I have seen other instances where it was very difficult to get a tracklayer, under similar conditions, to lay one 40-lb. switch in one eight-hour shift; as a matter of fact, it has been demonstrated that a good tracklayer, by exerting himself, can lay such a switch in one hour. Similar instances could be multiplied but these will serve to illustrate the point. It might be suggested that such differences in worker efficiency resulted from the varying amounts of pres-



sure applied by management to force the workmen to speed up. In none of the instances cited were the results obtained by slave-driving methods. Everyone responsible for mine output today knows that the hard taskmaster method does not produce results. Today high worker efficiency is accompanied by a cheerful friendly attitude on the part of both the worker and management; whereas low efficiency is usually accompanied by poor morale and bitter quarrelsome relations all around.

It is evident that responsibility and initiative in the field of worker efficiency must lie with mine management. Only by recognition of this fact and by careful factual analysis in each individual case can success be achieved. I will attempt here to outline some of the general problems that must be faced in any attempt to improve the ability of a management organization to influence the work attitude of the mine worker:

First, it is necessary for management to know accurately the maximum potentialities of men and machines. This information is not always easy to obtain. I am not a golfer, but I presume that one of the first things I would want to know in approaching a strange course would be the established par score. Likewise, the establishment of par production performance in mine operation is a good way to approach the problem of production efficiency. If conceptions about this par figure have been allowed to develop accidentally there is likely to be a very great error in the accepted figure—for example:—At one particular property it was generally believed that 400 tons in one shift from a loading machine represented peak performance—subsequently production of over 1100 tons was obtained on a series of test runs. This is not an un-

usually great error in popular conceptions about mine performance. The proper initial approach to the establishment of par performance for most operations is the intelligent application of careful time studies. Accurate time studies are not easy to get, nor is it easy to accurately interpret them, but both of these things must be done as a preliminary step to the achievement of efficient production. The principal value of such information, once obtained, is psychological. Mine management has no hope of success until it knows of what success consists. If people believe implicitly that they can do something—they usually can. Once top management becomes aware of the potentialities of the job, the next step is to effectively and convincingly establish this information in the minds of the supervisory personnel. Here again, this is usually no easy or simple task, but it can be done in every case and it must be done before results can come. As soon as possible, and by whatever means necessary, the accuracy of the theory being developed should be demonstrated. If time studies show that a machine can produce 150 tons per hour, the machine should be made to produce this amount at whatever cost and by whatever means.

Second, the will to produce must be developed within management personnel. This attitude of mind should be a permeating enthusiasm throughout the whole management organization. I am afraid it can never be produced by suspending a threat over each supervisor that he will lose his job, or be otherwise penalized, in the event he fails to produce. This is a weapon, which may, of course, be used on proper occasion, but if it is relied upon as the primary incentive, it becomes a boomerang tending to destroy sound relationships throughout an organization. The foreman should be made to realize



that he is the guardian of productivity and should be taught to regard this responsibility as a sacred trust. This calls for some study of sound economic principles and the discussion of such principles should have a place in the business of every mine management organization. Surprisingly few people have ever taken time to think about such things, much less to study them carefully. The average American foreman is sufficiently intelligent and honest to appreciate these ideas and to absorb them if they are properly presented. It seems to me that the whole problem of industrial psychology must rest upon a foundation of the understanding of a few basic economic facts. There is now, in all quarters, a greater awareness of the importance of productivity in modern life than ever before. The part American production played in the war has awakened the entire world to the outstanding achievements made by American industry. It has also awakened our own public to some realization of the fact that the foundation of what we call "prosperity" is industrial productivity. We are all excited by the economic confusion over wages, profits and social systems, but underneath all this we possess a fundamental realization of the unrivaled importance of productive efficiency. The American economic and industrial system has provided the incentive and the means for making the most of the expenditure of human energy applied to industrial production. Immigrant workers from any other land multiply their productivity and lessen the physical exertion they are accustomed to when they take a job in the United States. A Welsh or Scotch coal miner increases his usefulness about five times when he accepts a job in one of our coal mines. We are justly proud of these achievements, we are aware as never before, of their importance. If in-

dustrial management fails to capitalize on this favorable trend in public thinking, it will be guilty of a serious breach of duty—it will have failed to utilize a tool which might have been used to great advantage in the carrying out of its responsibilities. Every member of a management organization should be characterized by a philosophy based upon an awareness of these simple economic facts.

Third, every member of management should be made to realize his obligation to ownership. He should understand that ownership has entrusted to him the operation of its business and its hope for profits; furthermore, that his own personal prosperity depends upon the success of the business. These things seem so simple as to hardly require stating in a discussion of this kind. I am convinced, however, that we take entirely too much for granted about the thinking of the average foreman. It is unlikely that he will get these ideas straight in his mind and adopt the proper mental attitude unless somebody takes time to present them to him in a convincing and acceptable way.

Fourth, we Americans believe in the profit motive—we know it to be an effective means of establishing the will to produce. Every member of management has a right to expect that achievement on his part will be rewarded by an increase in his compensation. It is my belief that a Company policy, assuring him that such recognition of his achievements will be forthcoming, should be stated emphatically to him and should, of course, be carried out promptly when results have been achieved. In connection with this point, it is highly desirable that the foreman should have a clear understanding of the Company's financial position. He should be informed regarding costs, profits, competition, and general business prospects. An understanding of these



things will teach him how vital he is to the successful operation of the business. It will help to keep his thinking straight.

Fifth, work attitude within a management organization requires more than the understanding of certain theories and principles. The delicate balance of human relationships does not maintain its equilibrium without special effort on the part of someone, and general cooperation by everyone. No management is on safe ground unless the superior officials have the respect and liking of their subordinates and unless the subordinates have the trust and confidence and moral support of their superiors. This is too large a field to attempt to discuss in detail here. All sorts of excellent printed information on the subject are available. Any management organization that fails to make use of this information will fall short of its true possibilities.

Sixth, the eye must be kept on the ball. It is very easy to permit the diversion of attention from productivity to other problems. Good housekeeping is extremely important, but it is possible to make a fetish of it and to have everything in order to a nicety and at the same time experience low production performance. On the other hand, in almost every case high productivity is accompanied by good housekeeping. Safety is of extreme importance. It is possible, however, to allow safety programs, incentives, and awards to be over-emphasized and thereby divert attention from production. Here again good production performance is almost invariably accompanied by an excellent safety record. One of the tricks of those who oppose high production is to suggest that it is obtained by a speed-up system that maims and kills men. Bad management will produce accidents in any case. It takes good management to get production and a management

organization capable of making a mine produce is always capable of making it safe and as suggested above in most instances the measures taken to produce efficiency will simultaneously reduce accidents.

When management has produced within itself the proper concepts and attitude, the psychological problem is only half solved. It is the attitude of the workman that finally determines the degree of success to be achieved. The second half of the job, however, is usually much easier to accomplish. Nothing is more infectious than enthusiastic sincerity. If the management organization has indeed become enthusiastic about its job, this spirit will be caught by the workmen. This does not mean that high productivity will not be opposed by certain individuals, but if management makes a determined and intelligent effort, the influence of the opposition can be effectively neutralized. The ideas behind the attitude of management are so fundamentally sound and so understandable that it is possible to transmit them to the workmen.

If the thinking of the workmen is to be favorably influenced this must be done by the workmen's immediate superior. The section foreman and other final representatives of management must perform the task of morale building amongst the men. If these foremen are incapable of doing this, they are incompetent for their jobs. Here the leadership ability of the foreman is of primary importance. If he is truly a leader, his influence will guide the thinking of his men as well as their physical activities.

The foreman must sell himself, and his Company, to his men; he must win their loyalty; he must know how to obtain their active cooperation, at the same time maintaining their respect.



The coal miner is characterized by a very strong sense of pride in his work. This trait should be encouraged as it will prove a powerful influence toward increasing productivity. Friendly production rivalry among workmen can also be used to great advantage.


I am not going to make any effort here to cover fully the relations between the supervisor and the workman. Much has been written on the subject, abundant printed help is available. My primary purpose is to emphasize the relation of the mental attitude of management to the psychology of the worker. The miner is highly susceptible to the influence of the foreman, he is going to be influenced one way or the other. If the thinking of management is straight, if its convictions are clear and strong, a response will manifest itself among the workmen. The character of this response will be much more desirable than anything that can be produced by paternalistic social betterment schemes, or attempts to play "wet nurse" to the miner by interfering in his personal and family affairs. The worker resents this type of approach as he does not fail to sense that it has a detrimental effect on his self respect.

In the coal industry, prior to the advent of mechanization, we relied upon piece-work rates to provide the incentive for a large part of the production personnel. That this incentive didn't work very well is evinced by the fact that worker productivity reached a static level, or tended to decline. Wage incentive rates always have a tendency to associate themselves with low production rather than high production. This is particularly true in the mining industry due to the nature of the work which is characterized by factors affecting production that

are altogether beyond the control of either management or labor. In hand mining, tonnage rates were elevated to protect the income of the miner working under handicap of adverse natural conditions. In this way the whole hand loading industry has become penalized by excessive tonnage rates. I am opposed to piece work or worker bonus incentives of any kind in mechanized mining because I am sure that it would have the same effect there. Unquestionably piece work rates are a powerful incentive, and in some industries where they can be effectively designed and controlled, they greatly simplify the production problem. It is regrettable that they cannot be used more effectively in our industry. I am convinced that the only guarantee of worker efficiency and consistent progress in productivity in mechanized mining lies in the ability of the supervisor to develop work enthusiasm among his men.

Another pitfall on the road to efficiency lies in the temptation to permit machines to be operated far below their potential capacity. It is sometimes argued that it is more economical to operate machines at low capacities in order to integrate their performance with other operations in the production cycle. The economies imagined are usually fictitious, but even if they were real, the demoralizing effect of permitting low productivity from any unit usually offsets any other advantages.

If worker psychology has such a marked effect on productivity, it follows that progress in mechanization will be greatly retarded by any failure to recognize this factor. The merits of any piece of machinery, any method of procedure, or any system of operation cannot be measured unless real efficiency is first established. It follows, therefore,



that selection of equipment and methods will be on a haphazard basis where proper standards of productivity have not been developed.

In conclusion, let me attempt to brief the answer to the question I raised at the beginning, by saying that our mechanized mines are not as efficient as they would be if we could gain the whole-hearted cooperation of the workmen and such cooperation can be obtained when management produces within itself the proper mental approach to its job. High productivity has its origin in ideas—it must begin in the imagination of alert minds.