Scientific Management and the Knowledge Worker

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Abstract

During the industrial revolution, Frederick Taylor developed his Principles of Scientific Management, which have been the basis for industrial engineering for the last 100 years. However, with the advent of the knowledge worker, many believe his principles are no longer valid. Although today's situation is different from the one which Taylor faced, the similarities are striking. We live in a time of rapid technological change requiring the re-education of a large segment of the population. This is precisely the environment which fostered the development of Scientific Management.

Currently, much of management's attention is focused on understanding the process and the linkage of processes between various personnel and departments. While this is important, it is equally important to understand the tasks that added together are the process. Aerospace and government have understood the necessity to breakdown large complex projects and use systematic, disciplined approaches to define the total project in such a way that all elements are not overlooked and have a proper relationship.[1] In Japan, software development companies have major studies underway to understand the tasks the programmer performs and reproduce the best approaches in a systematic manner.[2]

Taylor took great exception to the idea of performing a task or set of tasks based upon guesswork, tradition, or rule of thumb. He believed that by analyzing the task through a systematic approach, the task could be made more efficient. Furthermore, his concept of *one best way* was meant as a method of determining an expected rate of production per day.[3] He realized the knowledge of how to perform the task resided with the worker, but he also understood the employee's need for feedback from management.

Today's manager can make a strong case for the use of Taylor's principles managing the knowledge worker. The Japanese and others have shown that the task of the knowledge worker can be systematized, and productivity can be increased using these techniques. Furthermore, the knowledge worker is a cornerstone of Taylor's work. In a real sense, this makes the Principles of Scientific Management just as applicable in the 1990's as in the 1890's.

The college graduate computer programmer of today is much more educated than Taylor's pig iron loaders. However, each has a need to have his task defined and to have the task understood by management. In other words, the laborer

shoveling dirt in Taylor's time is not fundamentally different from today's computer programmer.

Finally, there is ample evidence to suggest that human nature is still the same. Both types of workers have equal value as human beings, both have similar motivations, and both desire a level of direction and feedback from management. Only the task is different.

Therefore, if the Principles of Scientific Management put forth by Taylor are fundamentally correct, then 100 years from now scholars and practitioners will be studying and perhaps implementing NEW concepts similar to those put forth by Frederick Taylor and his Principles of Scientific Management.

Introduction

Numerous articles have been written on the knowledge worker and the service economy. Many of these articles suggest that with the advent of a knowledge/service economy. Traditional scientific managerial practices have become obsolete. Others argue that management's traditional role of directing workers should change to one where management and workers are equal and active participants.[4] Furthermore, industry management and politicians continue to struggle with these and many other issues, while in the meantime American competitiveness and perceived standard of living seem on an irreversible decline.

Finally, during times of stress, individuals often look their 'roots' for support. Similarly, management is well advised to study management history and draw upon the experiences of those who have faced similar problems in the past.

History of Scientific Management

A little more than 100 years ago the United States was primarily an agricultural society.[5] The Industrial Revolution changed that society forever in much the same manner the information age is changing our present society. The Industrial Revolution brought with it large numbers of untrained workers who moved into the cities in record numbers.

Additionally, all aspects of business were becoming more complex:

- Organizations were being reshaped by the demands for heavy capital infusion;
- There was a transition from small scale manufacturing to large-scale integrated factories;
- Personnel training and division of labor issues developed; and,
- Companies also needed to maintain profitability.[6]

Frederick Winslow Taylor, considered by many to be the Father of Scientific Management, developed, tested, and implemented his ideas in this socially and politically unstable and changing environment.[7] However, many of his ideas were controversial and not accepted.

The Principles of Scientific Management

The central theme of scientific management is the need to substitute industrial harmony and trust for warfare and fear in the workplace.[8] This harmony is accomplished by the following management practices:

- To gauge market trends and regulate operations in a manner that maximizes capital investment,
- Sustain the enterprise to assure continuous operation and employment,
- A continuous balanced operations whereby by personnel as well as the enterprise receive greater economic value,
- Develop a socially beneficial and healthier conditions of work
- Provide conditions for self-expression and self-realization among workers, and
- Promote a common understanding, tolerance and team spirit.[9]

Taylor was an early pioneer in the study of the work itself. It was from these studies that he developed his concept of the 'first class man'; meaning people are bested suited for a specific task and when placed in this task will perform at an optimum level. This concept places the burden on management to understand both the tasks and the employees' affinity with the various tasks.[10]

Scientific Management has been a controversial management style since its inception. Initially, its implementation was resisted by unions and others resisting change. Later it evolved into industrial engineering and merged with the thinking of others such as Frank and Lillian Gilbreth. It has had its supporters and detractors, but its impact on management theory and practice is significant.

The current issue is whether scientific management is relevant today. The dawn of the industrial revolution presented that society with similar restructuring problems faced by management today. However, this is a different time; the issues faced are similar, yet different. The question remains; can a modem knowledge based business process be enhanced by using a system developed by studying laborers shovel dirt.

Scientific Management Today

About 100 years ago the concept of scientific management attempted to define and improve upon our understanding of 'work.' which was commonly described as manual labor. Today most manual labor has been relegated to a machine, as new forms of technology change the way people mobilize to work. Furthermore, new kinds of skills and behavior are critical for productivity and change of this magnitude is frequently born with great pain and conflict.[11]

Often, when implementing major changes, management believes its older management systems are no longer relevant. Organizational science tends to be a product of its time, and this assumption is not necessarily valid.[12] It is time to re-evaluate Scientific Management and its applicability today.

Task Analysis

Taylor took great exception to the idea of performing a task or set of tasks based upon guesswork, traditional rule-of-thumb. He believed that by analyzing the task through a systematic approach, the task could be made more efficient Furthermore, his concept of 'one best way' was meant as a method of determining the expected rate of production per day.[13] He realized the knowledge of how to perform the task resided with the worker but he also understood the employee's need for feedback from management.

It seems simple enough to understand the task of shoveling or loading pig iron, but prior to Taylor, management did not understand these tasks any more than they understand the tasks of the knowledge worker today. What makes one employee or group of employees more productive than another? Much has been written in this area, but it is only recently that management has come to understand that even such a task as software development can be systematically analyzed and broken down into its fundamental components. Once this is done, then this process can be understood by others with a resulting increase in their productivity.[14]

Additionally, the costs for capital equipment and personnel are rapidly increasing for high technology firms. The only way to control this situation is by increasing productivity.[15] This can only be accomplished if the task and the process of tasks are more completely understood by both the employee and management.

Currently, much of management's attention is focused on understanding the process and the linkage of processes between various personnel and departments. While this is important, it is equally important to understand the tasks that added together are the process. Aerospace and government have understood the necessity to breakdown large complex projects and use systematically, disciplined approaches to define the total project in such a way that all elements are not

overlooked and have a proper relationship.[16] In Japan, software development companies have major studies underway to understand the tasks the programmer performs and reproduce the best approaches in a systematic manner.[17]

Planning

Taylor clearly states that the planning function should be different from the work; however, he felt his concept of harmony and mutuality would result in a spirit of cooperation between both groups. This thinking is in line with his concept of the functional foreman. Simply put, planning is another task requiring the specialized knowledge of the planner.[18]

On the surface, the separation of planning from the work is counter to the current idea of employee empowerment, which gives employees the authority and responsibility to plan and perform their tasks. However, empowerment requires three levels of reading and computational skills, job knowledge and interpersonal skills, and employees with these skill sets are difficult to find. Many people blame this shortage of critical skills on the educational system that is trying to cope with the needs of a diverse population.[19] Nevertheless, companies are having difficulty finding the trained work force necessary to be competitive in the knowledge/service based economy.

Systematic Work vs. Creativity

Many high technology companies provide working conditions that will allow their employees to be creative. They believe a pleasing environment enhances knowledge worn. Mayo and others have demonstrated that pleasant working conditions are important for a variety of reasons but are these hygiene issues any more or less important for knowledge workers than they are for non-knowledge workers. Furthermore, is all knowledge work really creative?

It would seem apparent that some scientific work is very creative. Much of the work; however, appears not to be. For example, designing a new computer program might be creative, whereas having developed the design document, the actual programming is very tedious and repetitive; the mental equivalent of shoveling.

Creativity is poorly understood, and without a better understanding of the origins and impetus for creative behavior, it is difficult to develop the appropriate organizational structure to accommodate creative individuals.[20] Furthermore, it appears that most knowledge workers are not actually involved in creative activities. To be sure management wants employees to take initiative, but this differs from creating new technologies.

Most workers will benefit and be more productive if their tasks are well defined. In their concept of situational leadership, Hersey and Blanchard segment follower

maturity into three categories: high, moderate, and low. Only the mature worker is classifies as one to who tasks can be delegated. All other segments require the leader either telling, selling, or participating with the worker in the accomplishment of the task.[21] The implication is that most knowledge workers are not as creative and independent as we may think they are, and subsequently require some level of direction in their efforts.

The Matrix Organization

Taylor's concept of the 'functional foreman' rearranged the traditional military hierarchical organization to one driven by the functional requirements of the organization. By developing this concept, Taylor recognized that knowledge of the worker was the most important asset. He was capitalizing on the strengths of several supervisors rather than relying on the judgment of one for the entire process.

The essence of Taylor's functional foreman concept was to insure that the supervisor of an activity was qualified to manage the employees performing the tasks. Today we might call an organization assembling a group of qualified employees directed by a knowledgeable supervisor a matrix organization. An employee may be required to perform a number of different tasks, and in the process of performing several tasks, might actually report to different 'functional foremen'.[22]

Therefore; in the sophisticated contemporary business environment of the knowledge corporation, individuals may serve on several task forces. Assuming each task force is directed by a supervisor with the specific knowledge required to accomplish the mission, it is apparent that Taylor's functional foreman concept is not only appropriate, but is typically implemented, even though it is not so named.

Scientific Management in Manufacturing

In the Flexible Manufacturing System (FMS) environment, the concept that FMS enables the company to have more control over the manufacturing process suggests that perhaps many of the industrial engineering principles that were used in the past are no longer valid.[23] FMS requires modem high technology such as Computer Aided Design, Computer Aided Manufacturing, and Computer Integrated Manufacturing. It is argued that in the new FMS environment, many of the labor practices such as the use of common work study methods to design jobs, set performance standards and methods of pay are no longer valid. However, Thompson et al states:

> Work force knowledge and skill levels are more important in the FMS than in a traditional manufacturing environment.[24]

Additionally, Thompson contends job design should be flexible and stresses the interchangeability of the tasks. Likewise, planning is important, as is the integration of functional disciplines. So while stating that scientific management is obsolete, Thompson argues that the new FMS requires that tasks be identified and understood, that good planning is essential, that the workforce be well trained and suited for the task, and that functional disciplines should be Integrated.

A strong case can be made that all these elements required in FMS are contained with the Principles of Scientific Management. While the implementation of FMS requires different specific tasks and new job skills, the situation today appears similar to that which Frederick Taylor faced. Finally, with the advent of techniques such as Statistical Quality Control (SQC), Taylor's aspirations of high quality and productivity performed by worthy individuals are met.[25]

Scientific Management in Software Development

Scientific management has had a profound impact since its inception, particularly in Japan[26] For example, large Japanese computer companies are earning approximately thirty percent of their information related revenues from business and process-control systems software, and seem to be developing this code faster and with fewer bugs than most U.S. firms.[27]

This is a story both the automotive and electronics industries have heard before. Once again, U S. industry IS faced with a formidable adversary. How can this be? Software development is in the hands of the knowledge worker. We believe that software development is the ultimate in the non-assembly line, individualistic, value added enterprises. Methodology is the big difference between the U.S. and Japanese software development efforts. Not as a black art dependent on the creativity of individual programmers, the Japanese have systematized the entire effort and software like any other product from an assembly line.[28]

There is a shortage of software development talent in Japan, so management has had to understand the skill level required to perform the software development task and develop standardized. Easy-to-use methods that will allow inexperienced personnel to accomplish the task. Using a rigid methodology with a clearly defined procedure, less skilled labor is used because the process is mechanical with a heavy use of software development tools, the predictability as a result of statistical process control, and compensation based on adherence to standards with an emphasis on planning.[29]

Clearly these are elements of Scientific Management. The steps and roles are well defined. Management takes great interest in the individual task as well as the overall processes. Employees are provided with an opportunity to be well

compensated for their work, and the process is standardized so that a proper 'first class man' can be successful.

U.S. Software Development

Most managers believe that software development 1s a process as opposed lo an art, but the steps are not as clearly defined as they are in other product development cycles such as computer hardware. Experienced managers argue that software development requires more effort in the planning stage to clearly define the new features of the product, a tracking method to keep the projects on schedule and within specifications, and testing procedures to assure quality.

Furthermore, empirical evidence has shown that in this environment, adopting a structured approach can reduce as much as 50% to 60% of the time needed to develop new software. Additionally, a core team consisting of representatives from software engineering, marketing, quality, customer service, documentation, and operations should management the software development process (Whiting. 1992).[30]

Conclusion

Are the Principles of Scientific Management, developed over 100 years ago, applicable today? In spite of numerous attempts to suggest otherwise, the answer to this question must be yes. The college educated software programmer of today is much more educated than Taylor's pig iron loaders. However, each has a need to have his task defined and to have the task understood by management. There is ample evidence to suggest that human nature is still the same.

Perhaps we understand issues such as motivation better today, and perhaps we can point to the fact that our standard of living is better. However, it is hard to refute the evidence that suggests the Principles of Scientific Management may be useful to today's managers.

Scientific Management was born during a period of great change, not only in technology, but also in society. The corollaries with today's economy are astounding. Once again, although not readily apparent as yet, the Japanese have taken U.S. business philosophy and optimized it in a production environment. While admittedly, the world is different today than it was at the turn of the century, the evidence suggests that the differences are minute.

To the extent Taylor was a product of his times, it is not the intent of this paper to turn back the clock. However, the principles put forth by Frederick Taylor are relevant today. If they are picked apart as they were during Taylor's time, then the message can be lost. Nonetheless, the Japanese have proven these concepts work and are applicable to any Industry.[31]

It is inconceivable the laborer shoveling dirt in Taylor's time is fundamentally different from the computer programmer of the 1990's. Both have equal value as human beings, and both have similar motivations. Only the task is different. If the Principles of Scientific Management put forth by Taylor are fundamentally correct, then 100 years from now scholars and practitioners will be studying and perhaps implementing NEW concepts similar to those put forth by Frederick Taylor and his Principles of Scientific Management.

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