TAYLOR'S SCIENTIFIC MANAGEMENT

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Abstract: *Frederick Taylor is known as the father of modern management. Taylor's scientific management revolutionized industry and helped shape the modern organization. Scientific management revolutionized industry because it explains how to increase production by working smarter, not harder. Taylor's ideas were not limited to only serving the company's bottom line but from the increase in productivity benefited the workforce as well. The principles of scientific management have become a machine of universal efficiency since there was a widespread use of scientific management worldwide and beyond the scope of the workplace. Taylor's theories on using science and statistical facts have become a guideline that many have followed to great success.*

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1. Introduction

The fastest way from point A to point B is a straight line. Scientifically, it is a proven fact. Mathematically, it is the shortest distance, therefore takes the less time. The travel of a straight line is an absolute

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model of efficiency at its purest. Frederick Winslow Taylor could not have agreed more. Taylor was a firm believer in using science and raw data to determine the most efficient course of action. Guessing was not allowed. Through research and meticulous analysis, only then could a process be established, fully grounded in scientific fact. It is these principles that allowed Taylor to establish scientific management, a management theory used to improve productivity.

Frederick Taylor, known as the father of modern management, was born into an affluent Philadelphia family, and studied engineering at Steven's Institute of Technology in New Jersey. Taylor began his career as an apprentice foreman and common laborer. He would quickly advance to chief engineer. His direct observations of men at work led him to develop what we would call "motivation" theory, although this is a psychology term that would not be imported into the management vocabulary until later.

Taylor called it scientific management. Taylor's own point of view, although benign towards workers, saw human labor very much analogous to machine work--- something to be "engineered" to achieve efficiency. His theories on management are promoted worldwide (and maybe took stronger root in Japan than in the U.S. or Europe) and would be controversial at home. (mgmtguru.com)

2. Industrial Revolution

In order to understand how Taylor's scientific management revolutionized industry and helped shape modern organization, one needs to understand what came before him. The industrial revolution had been underway for nearly 100 years before Taylor took his first job as an engineer at Philadelphia's Midvale Steel Company in the Fall of 1878 (Nelson, 1980, p. 29).

Most histories of the industrial revolution focus on technological developments, such as interchangeable parts, steam power, and the assembly line. Very little has been written about how nineteenth century plants were organized and managerial power was delegated. In virtually all industries, regardless of the types of manufacturing operations taking place, the foreman was, for all intents and purposes, the manufacturer (Nelson, 1980, p. 4).

The foreman had near absolute authority over the workers. He was responsible for hiring and firing personnel, training them, arbitrating grievances, promoting and demoting workers, and enforcing the manufacturer's personnel policies regarding work hours, personal appearance, and rules of conduct. In many industries the "piece work" system was common. The foreman set the wages using a "rule of thumb" method (Nelson, 1980, p. 8).

The manufacturer, for whom the foreman worked, usually watched the payroll very closely. When piece workers were so productive that they earned more than the prevailing day wage, the manufacturer would order the piece rate cut, removing any incentive to produce more. Combined with the difficult and unsafe work environments in many factories, there was a more or less permanent state of labor-management strife. Strikes and violence were common (Nelson, 1980, p. 9).

3. Scientific Management

In 1903, Taylor wrote *Shop Management* where he discussed his management principles. In it, Taylor theorized that workers were inefficient because they tended to ration their workload or work less than they could to prevent the job tasks from running out, resulting in a loss of wages. Management also failed to structure work effectively and to provide appropriate incentives. (mgmtguru.com)

Taylor would later elaborate on his management theories in 1911, when he published *The Principles of Scientific Management.* Scientific management consisted of four basic principles:

1. Replace "rule of thumb" work methods with methods based on a scientific study of the tasks.
2. Scientifically select and then train, teach, and develop the workman.
3. Provide detailed instruction and supervision of each worker in their given task
4. Divide work nearly equally between managers and workers, so that the managers apply scientific management principles to planning the work and the workers actually perform the tasks.

These principles clearly defined the workforce. Workers were charged with the physical labor and management was given legitimate authority to discern how the organization should be run.

Scientific management revolutionized industry because it explains how to increase production by working smarter, not harder. Up until that time, increasing output meant more hours, more employees, more raw materials, and more costs. Scientific management uses basic logic to show how standardization, productivity, and division of labor painted a picture of efficiency that resonates today. Not only does scientific management aid a company to accomplish its goals, but it improves the quality-of-life of the workforce, creating a win-win situation for all parties involved.

Creating standards is at the core of why scientific management is a beneficial organizational model. Standards are universally accepted guidelines that help govern procedures and courses of action for given scenarios. A common bottleneck that organizations face is “rule-of-thumb” or guess-work when it comes to dealing with issues, by not having a clear path to follow. Having a standard in place would eliminate this uncertainty and allow the wheels to continue moving forward.

“The standard” should also be looked at as a benchmark, a level or point of reference from which measurements can be made. Measurements allow for an analysis of productivity. They are used to identify how efficiently employees, processes, and procedures met or exceed the standard.

"The system's base was research and experimentation to replace the old 'rule of thumb." (Wrege, 1991, p. 255) Research under scientific management is the collection of raw data. Research is one of the most crucial components of developing a standard. The raw data gathered can be measured. It’s something tangible, something that can be accounted for.

Two classic examples of scientific management increasing productivity and benefiting the workforce are the pig-iron and shoveling experiments Taylor conducted. Pig-iron is a term used when melted iron is allowed to flow into a gridiron of damp sand, creating bars that can then be handled. Using time study, the study used to reduce the number of motions in performing a task, Taylor was able to gather the raw data needed to analyze a specific task. "The idea of 'guessing' about the time required to perform a job was against Taylor's basic outlook" (Wrege, 1991, p. 54). Taylor began using a stopwatch to first study what the machinery would do and the time it took. Then he studied the individual worker. This allowed Taylor to record how long each process took and discover which processes took the most amount of time, discovering any bottlenecks.

Taylor's analysis showed that an average worker loaded 12.5 tons of pig-iron per day. On the high-end of the spectrum, workers were able to load 48 tons per day. Taylor realized that a specific skill set was required in order to load those 48 tons. He studied the characteristics, work ethic, and habits of top-performing iron handlers. Those methods were recorded and used to scientifically select the workman. "Our first step was to find the proper workman to begin with." (Taylor, 1911, p. 61). Workers were then brought in that matched the skill set of those that were able to load 48 tons per day.

Taylor's study also showed that there was a specific method of pig-iron handling and shoveling that yielded the best results. "One man after another was picked out and trained to handle pig iron at the rate of 47.5 tons per day until all the pig iron was handled at this rate" (Taylor, 1911, p. 61). By studying the raw data collected, Taylor was able to determine not only the type of worker that was needed to handle the task, but also determine the "one best way" of completing said task. "I have not the slightest doubt that different size shovels and implements for handling dirt have been in existence for hundreds of years" (Wrege, 1991, p. 122). Taylor was able to prove that the weight of the shovel, the weight of the load, the angle at which the load was lifted, and the technique used to dump the load all had an impact on output. Scientific management was able to increase productivity by roughly four times.

Taylor's ideas were not limited to only serving the company's bottom line. The increase in productivity benefited the workforce as well. Workers were paid by "piece rate," a fixed wage for each unit produced or action performed. This generally failed because standards were poorly set, employers cut rates when workers earned "too much", and workers would conceal their real capacity for production to keep standards low. In order to rectify this, Taylor pushed for standards to be set for wages. A clearly defined wage should be established and be directly related to the complexity of the job. (mgmtguru.com)

Scientific management had increased a worker's output, allowing them to take home a greater pay than ever before. Under the system, incentives were offered for greater output. Even in modern times, this principle holds true for those that earn bonuses from commission.

The increased output did not come at a physical cost to the worker as one might assume. For those not under scientific management's guidelines,

increased output meant that the worker had to work harder and work longer hours. Scientific management preached efficiency in order to increase output. Workers did not need to physically exhaust themselves. They needed to work smarter.

Although jobs were made easier and simpler, physical labor is still demanding on the body. Taylor observed that the pig-iron workers could not keep a sustained output of 47.5 tons per day. By the fourth day, the worker was too exhausted to function at his normal pace. Through his experiments and research, it was determined that rest breaks were needed in order to prevent diminished results. Again, through meticulous study, the precise type of rest, the duration of rest, and frequency of rest period were all calculated to yield the best results. "The men were made to take a rest, generally by sitting down after loading 10 to 20 pigs" (Taylor, 1911, p. 61). Even if the men were not tired, they were forced to take the recommended rest in order to sustain the output of 47.5 tons per day throughout the work week. Workers today continue to benefit from breaks during the course of their shift.

Scientific management also laid the foundations of how businesses should be run from an organizational standpoint. Separating the workforce from management proved to be a recipe for success at the time. A job required a specific type of employee and at the same time, an employee was matched to a specific job that suited him. Management was left to improve other aspects of the business.

Managers were taught to look at every aspect of a manufacturing operation as a piece of an integrated system. Improvements made to one process would lead to improvements to a different process down the line. "The idea that every part of a factory or a whole organization should be scientifically analyzed and redesigned to achieve the most efficient output" (Wrege, 1991, p. 255). Managers could continue to use time study to improve and eliminate bottlenecks. Instead of leaving the workers alone to solve problems they might be confronted with, management would be able to determine the best course of action scientifically and then train the worker to perform the task accordingly.

Separating the workforce allowed businesses to operate more efficiently. The worker would concentrate on the day-to-day tasks asked of them, and not have to worry about the decision making. Decisions were left to management who were able to take the best course of action after

careful study, planning, and implementation of pre-defined standards. "Taylor was helping to create the modern white-collar workforce" (Kanigel, 1997, p. 351). Taylor was able to create a system, founded on issues during his lifetime (production, order, efficiency, labor), that could transcend time and be beneficial to age, be it past, present, or future.

4. Widespread use of scientific management

Frederick Taylor died of pneumonia in 1915, just five years after the publication of *The Principles of Scientific Management* brought him world-wide recognition. Scientific management soon became a machine of universal efficiency. The *Principles of Scientific Management* were translated into Chinese, Dutch, French, German, Italian, Russian, and Japanese (Kanigel, 1197, p. 22).

Ironically, one of the first countries outside of the US to make widespread use of scientific management was the newly formed Soviet Union. Lenin, who was familiar with Taylor's work, believed that in order to transform the USSR from the nearly feudalistic country that it was under the czars into a major industrial power, a mass educational effort was necessary. In fact, Vladimir Lenin believed that Taylor's methods could be used to manage the entire nation: "We should immediately introduce piece work and try it out in practice. We should try out every scientific and progressive suggestion of the Taylor System…..The Soviet Republic must adopt valuable and scientific technical advances in this field. The possibility of socialism will be determined by our success in combining Soviet rule and the Soviet organization of management with latest progressive measures of capitalism. We must introduce in Russia the study and the teaching of the new Taylor System and its systematic trial and adaptation" (Wren ,1980, p. 1).

The Soviet Union's famous five-year plans that set goals for industrial productivity and economic growth were a direct result of scientific management principles (Wren, 1980, p. 4).

As Taylorism was influencing the growth of the USSR during 1920's, Japanese industry also began adopting Taylor's techniques. One of the first disciples of scientific management in Japan was a man named Ueno Yoichi. In 1919, Ueno was hired by the Lion Toothpowder Company, where he increased the productivity of its packaging department by 20 percent while

reducing the area of working space by 30 percent and cutting work time by one hour per day. Uneo became a leading proponent of scientific management in Japan, In the years leading up to the Second World War, many in Japanese industry embraced Taylorism (Tsutsui, 2001, p. 446).

As scientific management became more popular in industry during the early part of the twentieth century, it began to influence other segments of society and culture, particularly in the progressive movement. For example, the famous conservationist Gilford Pinochot, who was appointed by President Theodore Roosevelt to head what is now known as the Department of the interior, saw his work as, "efficient management of natural resources." Progressive reformers, who were interested in reducing public corruption carefully, began to study things like the amount of money spent on constructing things like sewer lines verses the amount of people living in each square block. Home economists, many of them advocates of women's suffrage, did time and motion studies of house work in the hopes of relieving some of its drudgery, in the hopes that it would give women more time to educate themselves in order to become better participants in American democracy. A certain type of technical utopianism emerged (Schwartz-Cowan, 1997, p. 212-213).

Scientific management has also spread beyond the scope of the workplace. Most armies around the world employ scientific management. In virtually every facet of armed forces, there is a standard method of performing each job. Enlisted men are drilled time and time again to complete specific tasks in a specific manner until they become routine. Those with appropriate abilities for a task are then made to perform only in that task. Essentially, the job is matched to the worker. Those with keen eyes become snipers or scouts and those with an understanding of strategy are promoted into "intelligence operations."

Along with the utopian view of the scientific management, there emerged a growing public backlash. In 1911, workers at the Watertown Arsenal in Massachusetts, where Taylor was employed, went on strike in support of a worker who refused to allow engineers to time what he was doing with a stopwatch. The incident received a great deal of newspaper coverage and led to Congressional hearings at which Frederick Taylor was called to testify. One of Charlie Chaplin's most famous movies, Modern Times, parodied scientific management. The film opens with an image of a clock and shows workers toiling on assembly lines. Chaplin's character is

even fed food by a machine, and later gets sucked into and becomes a part of another machine (McKenna, 2006, p. 37).

Today, with the benefit of nearly 100 years of hindsight, many of the Taylorism's shortcomings are glaringly obvious. The "one size fits all" approach to motivation, the consuming focus on efficiency with a near total disregard for quality, and the deaf ear held by management to suggestions by subordinates seems very out-dated by today's standards. But Taylor's scientific approach – the application of statistical techniques to production and efficiency, and his focus on what motivates workers, set the stage for what would come later.

While workers in the US and in Europe resented Taylorism with its incentive wage schemes and work specialization and simplification, that was not the case in Japan. Although some of the reasons for this are open to interpretation, many Japanese workers saw scientific management as elevating their status as "modern factory workers." Scientific management delivered on its promise of elevating wages, and some workers even saw it as an honor to be the subject of a time and motion study (Tsutsui, 1998, p. 39).

Even with the use of scientific management techniques, there were important cultural differences between the Japanese approach to management and that of their American and European counterparts. Their management style was much more paternalistic, perhaps derived from the traditional Japanese feudal relationship between lord and retainer. There was a strong value among both managers and workers for harmony and cooperation (Tsutsui, 1998, p. 49).

5. Deming's approach

After the bombs of World War II destroyed most of Japan's industrial capacity, the morale of workers and managers was extremely low. If post-war Japan were to succeed, a new approach to management would be needed. They found that approach in the teachings of Dr. W. Edwards Deming, an American engineer, statistician and management consultant. During the war, Dr. Deming helped develop and teach statistical control methods in order to improve wartime production. After the war, Deming made several trips to occupied Japan and met with Japanese engineers and managers. Japan embraced Deming's philosophies, and in the years that

followed an entirely new style of management emerged (Nixon, 1962, pp. 119-120).

Deming's new style of management placed quality and the customer above all else. It also required an entirely new approach between managers and subordinates. Where Taylor saw the customer as wanting quantity, Deming saw them as wanting quality. Deming's approach to motivations was the polar opposite of Taylor's top down approach to management. In its place Deming advocated a team approach where the manager was leader, but where the contribution of each team member was important. Taylor emphasized job simplification, but Deming emphasized job enrichment. Perhaps most interestingly, Deming saw Taylor's financial incentives to workers as being counter productive, because they created winners and losers within the team, creating disunity of purpose. Today in Japan, W. Edwards Deming is viewed as a visionary in much the same way that Frederick Taylor was seen in the US during the early years of the twentieth century. (Swiss Deming Institute chart).

6. Conclusions

Some readers many see Deming's methods of Total Quality Management as being a repudiation of Taylor's scientific management. Such a view is rather short sighted. Frederick Taylor was one of the first people to view management as a science to be studied. He was the first person to study motivational theory, and apply statistical techniques to manufacturing. At a time when labor was cheap, supplies were plentiful, and manufacturing processes were relatively forgiving of quality control issues, scientific management was a tremendous improvement over the old factory systems with its tyrannical foremen and rules of thumb.

All technologies evolve. Jet airplanes would have never come about if they were no piston engine airplanes before them. The work of the Wright brothers was not undone by those who helped develop much more advanced aircraft. Frederick Taylor helped make the modern organization possible. He provided the foundation upon which much of what came after him is built.

Frederick Taylor revolutionized the way we approach businesses and organizations. His theories on using science and statistical fact have become a guideline that many have followed to great success. Is scientific management a perfect system? No. However, one cannot deny its

contributions to society and measurement of efficiency. It is through these principles that we can clearly set the standard of a straight line, being the most efficient way to travel.

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