Introduction of New Management Concepts

When Scientific Management came to Europe

Jørgen Burchardt
researcher affiliated National Museum of Science and Technology,
Fabriksvej 25, DK-3000 Helsingør, Denmark
www.burchardt.name

Abstract

F.W. Taylor's ideas about Scientific Management had in fact only a limited impact on management practices before 1920. Worldwide, the system was only successfully implemented in maybe 5-6 organizations. In Denmark, an early introduction of the system took place at a plant during a ten-year period from 1905 to 1915. However, a change in top management led to parts of the system being abandoned.

It seems that the failing break-through of Scientific Management in its first period was not caused by resistance from the labour unions. On the contrary, the resistance came from conservative oriented top managers who often put the brakes on the introduction of new management systems.

New management methods will not automatically emerge as a consequence of structural, technological, or competitive necessity. The implementation was often carried through by a personal enthusiasm. It was this excitement in itself that became influential, and not the specifics of the new methods, as most parts of these were already developed in the preceding century. The most important was the charisma of Taylor and his popularity due to his introduction of high speed steel in 1900 as an almost political or religious movement with an overweight in the iron business.

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Introduction

"Gentlemen! When the Association of Engineers has invited me to give a lecture on 'Modern Factory Organization' specifically for' the Taylor system ', this is so proud to me and so important for the case I work for, that I did not avoid to take up this offer, despite the fact that I am extremely busy and time does not allow me to prepare enough for such a lecture".[1]

Thus began director Walter Engel in his lecture to the Association of Engineers on the 15th of March 1916. It was the first time the Danish industry was really presented with the new ideas of Scientific Management. In Europe the World War raged, which gave business people enough to think about with its difficulties in obtaining raw materials and with changes in marketing conditions. But for Engel, it was a great day for him. For the first time he could stand face to face with colleagues as he presented his great passion, Scientific Management, or the Taylor system as it was synonymously called. Not only would the audience hear of Taylor's theories, but they would, more importantly, hear how Engel himself through several years had practiced the ideas at one of the largest industrial companies, NKT (Nordic Cable and Wire).He had been able to do the job rather unnoticed, because it happened at the plant, Trådværket, in the provincial town Middelfart far away from the capital. There were not many professionals who had know him during the ten years he had worked in Denmark, but that was about to change. With his great theoretical and practical knowledge of iron manufacturing, he was about to become an important person in the attempt to produce iron for the Danish industry.

The day was not only a great day for Engel. It was also an important day for the Danish industry, where modern ideas were being introduced to Denmark for the first time. Certainly we could read about Taylor's ideas in books in English, French, and German. The Frenchmen got his first major work "Shop Management" as early as in 1907, only four years after the American version. In the following years the book was also published in German, Dutch, and Russian. The second major work "The Principles of Scientific Management" was published in English in 1911 and was released more quickly in other languages: the same year in France, and in subsequent years in the Netherlands, Russia, Germany, Italy, Japan, Russia, and Sweden. None of the books were published in Danish, and the Danish industry had not yet had an opportunity to seriously discuss the ideas, until now. The only Danish mention of Taylor was presented by Engel who had written a short obituary of Taylor after his death in 1915. Engel could therefore present this lecture with the conviction that not even the Polytechnic had taught their students in this discipline.

Frederick W. Taylor

During the lifetime of Frederick W. Taylor, people were thrilled by the exact sciences. They gave insight

1 All references to the Danish history are from Burchardt 1999.

into a wide range of natural laws that the industry had been able to use in the manufacture of old and entirely new products in unprecedented qualities. Similarly, the American Frederick W. Taylor (1856-1915) wanted to develop a science involving the study of work (laboratic was the term that it was given by Engel). From this scientific basis, the practical guidelines of the so-called Scientific Management would be developed.
Taylor has since been known for the development of pay systems that contained a powerful incentive for workers to increase their pace. The piece-rate system was set in into place.

Another important tool that Taylor developed was the so-called time-study that could be used to determine the piece-rate. Time studies were the scientific measurement where the new tool, the stopwatch, could measure very short time periods. Through this, the work could be dissolved into its individual components. By combining the individual time-share together the maximum theoretical performance could be obtained. However, a worker could never reach the theoretical performance, because he had to have a break, to wait for materials, etc. But the time studies became a practical tool that could be used by planners to reduce unproductive periods.

Taylor had, as a young man, worked many years working lathes. Here he experimented to find the most optimal method. By the time he had created many inventions (his more than 40 inventions also included some of his hobbies: he designed a golf putter and a tennis net), but it was the invention of high speed steel which really made him well known in professional circles. He presented the ideas of rationality in 1895 in the lecture "A Piece-Rate System". Then he worked until his death to refine and develop the entire techno-economic side of the production problem. As times went on the time studies were only a small part of his idea. He eventually created a system which covered the whole factory's organization to be organized after the main principle that all planning work should be separated from the manual work. This meant that companies should have a planning department where the real brain work was done. Below this management level would be a series of foremen who only had to make sure that the instructions from above were followed. Finally, the workers would perform the work as correctly as possible. To make the system work, it was necessary to develop a bureaucracy with time sheets, control charts, etc. The ideas were tested in practice in different companies. Taylor served as consultant and adviser, and later this work was taken over by a group of his disciples. The main aim was ultimately to get workers to produce more and faster. Taylor emphasized that the work studies could be used to organize the working moments better so that the workers would not be overworked. The tools could be improved, and the entire workplace could be better arranged.

The American Frederick Winslow Taylor (1856-1915) became the man that summarized the new ideas of his time about management.

The first Danish organization and contractual system was created

There are two main reasons why it was on NKT's Trådværket in Middelfart that the new governance was first introduced. One was that Trådværket was a completely new type of industry that was introduced in Denmark in 1899 when the factory and its first wire drawer were ready for production. The second was the director Engel personally. The factory in Middelfart was modeled after a factory in Germany. The buildings, railway location, and installed technical devices and machines were built after the same model.
However, there was an area that was not copied by NKT's leadership: the way work was done and organized. Work in the German factory was carried out by skilled workers. The Danish business people instead wanted that all work at the factory was done by unskilled labor, while only the most necessary blacksmith work was carried out by a skilled tradesman. This would provide flexibility for organizing the factory so that they could move people from department to department without considering that person's official training.

The German engineer Walter Engel (1879-1974) was the first in Denmark to introduce Scientific Management after he was employed at NKT Trådværket in 1904.

The goal was about to fail, because among the workers, who in construction phase were sent to Germany for training at the German factory, was a worker who came from Southern Jutland, and therefore could understand the German language. The managers of Trådværket discovered their mistake in time. They immediately arranged for his removal from the German factory, before he could tell learn and teach the future work colleagues in Denmark how the work was made by trained persons.

Once the factory was established, past farm workers streamed to Middelfart to get jobs in an industrial company that could provide a much higher wage than agriculture provided; at the same time it gave them a relative short workday and by this more leisure time. Very soon after the plant's startup agreements with the unions on piece-rates were signed. The employer accepted the unions and didn't fight against them as did many other employers in the turbulent years around the turn of the century, but rather encouraged the workers to organize themselves in order to be entered into collective agreements.

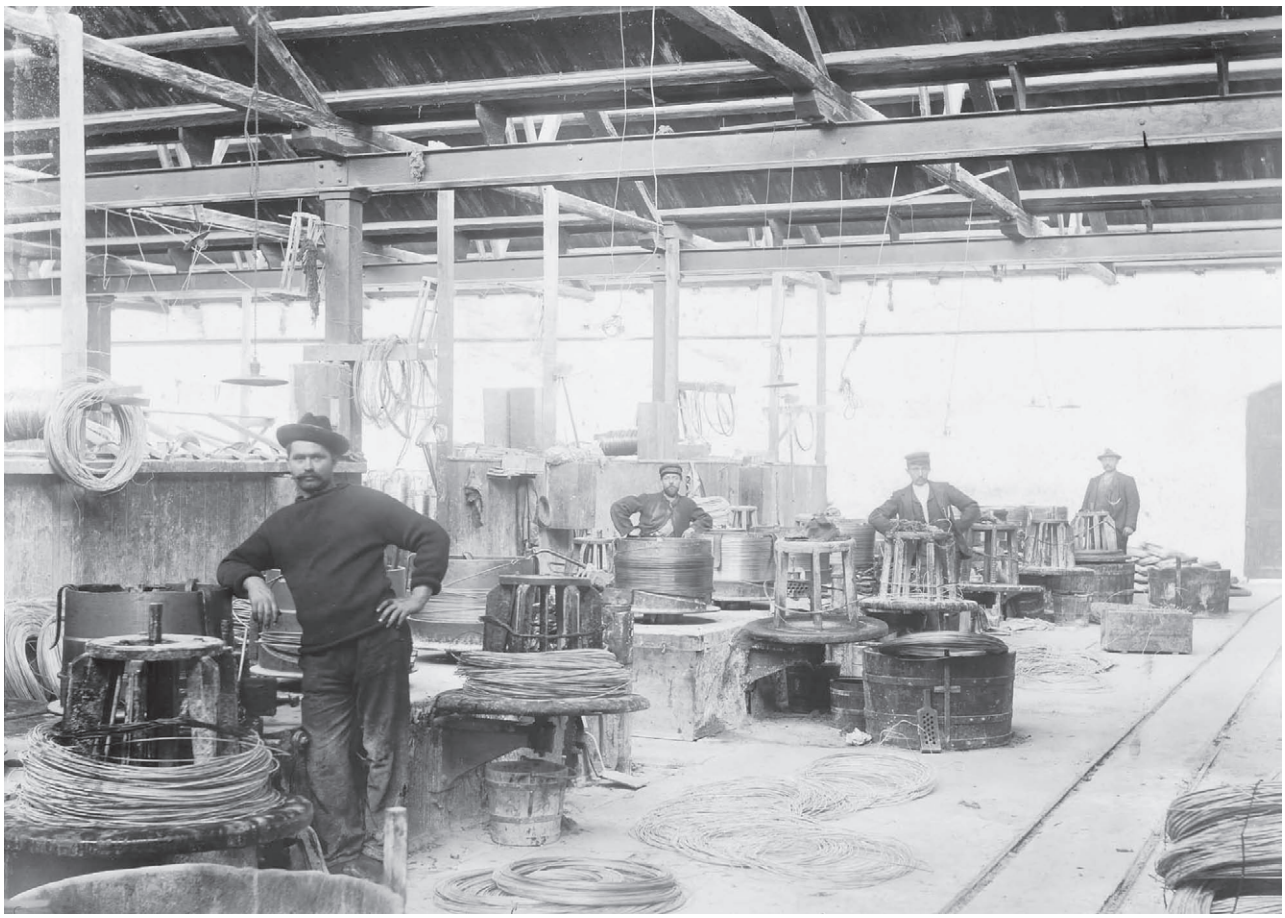
Some part of the work on the factory included work that could not be put to a piece-rate, so it was performed on hourly wages. It was work like carrying items around the area. This work became the equivalent to work of varying kinds which the skilled blacksmiths and machine minders performed. The clerks and porters were paid monthly as officers. Most of the work was done as a repetitive process by machines or were otherwise what we today describe as 'repetitive work '. It was this work which was promptly put on piecework. In the end, it was determined that the workers had signed agreements that did not give them a greater advantage over hourly wages; in some cases their piece rate pay was even lower. Gradually there was a level found suited both employers and employees.

After large replacement of mid-level managers in the early years a stable organization was gradually built up. Each major department of the factory was headed by a professional, often a German expert. Often living in the subdivisions were Danish machine minders or former officers from the military which in practice had proved that they could lead and manage a working group.

The first educated engineer came to the factory

As mentioned, the physical factory and its organization were copied from a German factory, and only minor modifications were made. Thus, the factory was a functioning workplace that belonged to one of Europe's most modern. The method of copying another factory was not viable in the long term. There needed to be an on the spot person who could contribute to the factory's continued development and renewal. Therefore the managers decided to hire an educated engineer in 1905. It was then that not even very large industries possessed a theoretically educated person. They relied on the practical skills that craftsmen had acquired in traditional education through apprenticeship and through experience during "wander years" working at different workshops, mainly in Germany. The Polytechnic had trained graduates since 1829, but most of those few graduates had previously been allocated as port engineers and in similar public employment.

This first appointed engineer was the 25-year-old Walter Engel. He was born in Berlin, the son of a lithographic printer. He was obviously of German nationality, but had actually become more Danish than German. His father had no family, since his parents died early and he had no siblings or cousins. The family therefore turned fully toward the mother's family, and because she was Danish, the home became very Danish. They spoke Danish, are Danish food, and her Danish family members came to visit when they crossed into Berlin.



There were many repetitive work moments at the NKT factory, Trådværket in Denmark. Scientific Management was gradually introduced from 1905 but was stopped in 1915 by a new manager.

Engel began his training as a Mechanic in his grandfather's business in Copenhagen, and he later went to Berlin to continue studying as a mechanical engineer at the technical college. After some years he continued his studies as a chemist in Berlin, Tübingen, and Copenhagen and finally completed a doctorate from Berne in Switzerland, where he continued to work with the well known metallurgist professor Friedheim. The promising engineer then spent just under two years working in the best German factories to learn about the practical elements of working with iron. Either he worked as foreman, or if he could not get that job, as an ordinary worker. He learned to work at foundries, mills, and wire drawers. It was his capacity in these areas which could make him the choice for Middelfart.

Trådværket: Denmark's first experience with Scientific Management

Engel became associated with Frederick Taylor in 1904-05 when he worked for a German company in the steel industry.[2] The director wanted to correspond with Taylor, but when he could not master English, he asked Engel to help him. Hereby a contact was established. In Middelfart he started a lengthy correspondence with Taylor concerning practical rationality problems at the factory. Through his position at the factory, he had been given the opportunity to introduce new ideas, although the trade-educated factory director over Engel had the formal leadership on the plant.

One of his first jobs was to make a description of the existing organization, which Engel already implemented in 1905. The next step Engel took for the factory's improvement was taken in 1907 when a staff clerk was employed. Some of the clerks' tasks were to compile statistics on the production and over the consumption of raw materials and electric power. The clerk was later joined by two statisticians who reviewed the statistics over the stocks starting in 1909. Yet the existing administrative system was not touched. It was, as mentioned, built on advices from a Germany plant. The German director had even been to Middelfart to verify that the one accounting system could control each individual department. He also brought several forms from his plant, including wage and piecework lists that people in Middelfart were

2 The information is from Engel himself. The connection with Taylor is not confirmed from other sources.

able to copy.

In 1910, the factory's director died in an accident, and Engel was appointed as the natural successor. This tragic circumstance meant that it was easier for Engel to implement his ideas on Scientific Management. Now the plant could be seriously reformed. In a letter to all Trådværket officials Engel wrote, "Hereby the care of the workers will be centralized on one hand, and abolish the unfortunate fact that workers who in one department under one manager has been unable to get satisfactory working conditions, can be placed in another department, where he is better suited." First the staff was redeployed. Notably one of the German foremen was appointed to be a work manager over the entire factory. The individual foremen had until then run their departments rather independently. One of his key responsibilities became the recruitment and dismissal of employees; at the same time he was in charge of solving the more technical tasks in the workshops. The foreman or works manager was also responsible for the Labor Bureau. The Labor Bureau was ready in December 1910 to take responsibility for production management.

Working notes and forms were now essential tools. Timesheets were placed on a wall table so that there always was an overview of which workers and machines were assigned to different orders. Maps were hanging in three sets on each machine: one for orders ready for processing, another for work in progress, and the last for incoming orders. Prior to each month, the agency calculated how much each machine would perform. Another important form system kept track of individual employees' time. Their cards were stamped on control clocks as soon as work started and ended.

There were also statistical records introduced in a modern and clear form. The plant was divided into as many smaller factories or subsidiaries as possible (today called performance centers). The desire was to carefully calculate each product ion. There were 22 units formed, each with its own independent operation and its own independent bookkeeping and accounting. 19 of these 'factories' bought and sold semi-finished goods from each other. There were also three additional sections: generalia, administration, and a dispatch office. To an outsider it may have seemed like an overwhelming bureaucracy, but there were only three people to manage the statistics. They each led a so-called 'agency'. The bookkeeper was responsible for bookkeeping for the entire factory, so it became possible to calculate the costs for each department. The calculator calculated the costs that would arise from an imaginary order, and final a statistician acted as an information office for all leaders in the company. There were summaries prepared concerning current production per days, months, and years. Of particular interest was the new idea of ongoing monitoring of future production, the supply of raw materials, and the expected production volume in conjunction with sales.

These agencies should not be confused with the factory's genuine commercial agency. It worked with purchase and sales and had the matching cash accounting, correspondence, etc. as in other businesses. This work had been improved significantly in 1908, when an employee spent a long period of time learning to work with the system in the main department in Copenhagen.

The first time studies

Now that the organization was in place, Engel could proceed with the next step toward modernizing the factory's organization by creating contracts based on time studies. The preparation of the first of many piece-rates was conducted in the spring of 1911, but was already in the course in 1910 when information on the previous chords were written down and assembled together. The preparation was divided into four parts: the work description, time studies, piece-rate fixing, and negotiations. The descriptions of the work processes were fairly detailed, but could still generally be on one typed A-4 page. The work was easy to describe, while there were often problems with the many secondary functions. Should, for example, maintenance of machinery be carried out by a blacksmith or the worker of the machine?

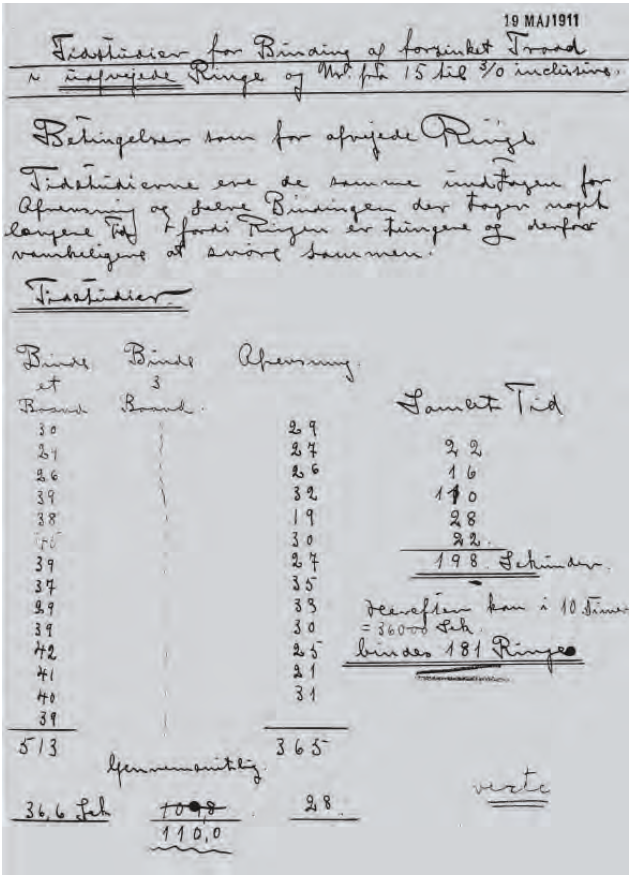
The next process was the actual time-study of each part of the job. There was an average time measured for every single task in the factory. The average was calculated using a very large number of time measurements. Even for many rather uniform machines it was necessary to conduct multiple measurements, because the work was made with many small variations. For example, there were a myriad of different dimensions and qualities of wire, so there needed to be a measured time for each type of thread. From these measurements the piece-rate could be determined by some complicated calculations. An important result was 'the theoretical output'. It was the maximal production that a worker, in a steady pace, could perform if he had no breaks or waiting time. By setting this theoretical production compared to the regular hourly wage, it was possible to determine the price per unit.

Engel had the same view as Taylor that the time study was an objective method to determine salaries. When the unions were opposed to the timeline studied chords, Taylor assumed that it was due to the fact that scientific piece-rates widely would make the unions unnecessary, since they no longer would have to deal with wages.

In practice Engel and his associates rarely used time studies alone. They were used as a basis for negotiation, which also included the earnings that the workers had achieved doing the same work in the previous year. Thus, in 1916 in a debate on the agreement over a special type of wire the leadership first reviewed the time studies and did a calculation of the theoretical output, but when the piece-rate was determined, they took in account the workers contract "of old days."
The purpose of time studies went wrong when something in the manufacturing process was changed and had an influence on the contract. In this way, it was in the workers' favor if there were introduced labor-saving methods and machinery. Conversely, it was a problem for them if the situation deteriorated. Raw materials of poor quality could, for example, destroy a contract, and in many departments the whole piece-rate system therefore almost broke down under the First World War.

At a large factory like Trådværket, with 300 employees, there were many different types of work for which the piece rate could have many different forms. One of the special forms was in the warehouse where all staff had a common contract calculated from a certain number per tons of handled goods. Receiving beyond this amount was the ganger (which was not the foreman) who received an award calculated according to the department's work, measured in weight. He was thus rewarded for his ability to make the whole workforce be as effective as possible. With the additional speed, however, the work was not to be done carelessly, and the ganger received a fine for each complaint of incorrect handling.

The trade unions continued to be involved. The steward assisted the workers when the managers made a contract offer. The bid was reviewed and the worker could subsequently sign the composition, if he accepted it. In principle, it was a relationship between the individual employee and the company. Only major restructuring of duties became a task for the union at the highest level. Although in 1918 the trade union was more involved when a three-month notice of termination was introduced.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This piece-rate of 1911 is probably the first contract based on a time study in Denmark.

Within a few years a very large part of work at the factory was done by piece-rates based on time studies. How much the new piece-work contracts meant for the factory's improvement is difficult to determine when there was simultaneously improved machinery being introduced. The factory itself, in 1915, indicates that the Taylor system had caused a growth for one department's daily production from 15-16 tons to 18-20 tons, representing a progress of around 13-33%.

The hourly-paid workers were also affected by the new system. Engel wanted to improve the past simple control system. In the old system, each employee moved a number token when he came to and from work, including to and from lunch breaks. Engel sought to have six Rochester control clocks, but faced opposition because the board felt that the price of clocks was too high. The price was equaled an astronomical sum of 3,000 Dkr. but the control clocks were acquired in 1915. According the written rules the worker had to be ready to work when he stamped in. First he had be changed and then was allowed to stamp his time card at the switches which belonged to his department. With the clock it was also possible to check the length of over work and other deviations from the daily working day.

The fate of the Taylor system

In 1917 there was again an incident that changed Taylor's fate in Middelfart. Walter Engel was replaced as the director by the slightly older Oscar Tuxen (1874-1953). Tuxen, like Engel, was trained as an engineer. His Danish education was complemented by training in electrical engineering in Germany and England. He had a thorough knowledge of the written and unwritten rules and tricks in international business, gained from his years as director of Brown Boveri's German department. This new director was a business leader of the old school, and many of the modern ideas at the factory were abandoned. He had a very relaxed relation to time studies, which apparently went out of use shortly after he came. He was quiet about the methods of scientific management, and the factory went back to the old ways for making agreements with the workers. The shop steward and the employer created contracts on a rough estimate, built on their experiences and on production statistics.

It is difficult to show whether the Taylor system affected the working conditions at the micro level of the individual employee. However, it is indisputable that certain parts of the system were there to stay. The established organization and its bureaucratic routines continued at Trådværket. The numerous accounts over consumption of raw material and statistics were particularly appropriate in the construction of a company where the manufacturing took place in one place and the headquarters were in another. With some modifications the system was introduced throughout NKT's whole organization, and it remained almost completely unchanged for more than half a century.

Shortly after he was terminated as director in Middelfart Engel established a one-man consulting firm, perhaps the country's first of its kind (even in England, many years later, in 1931, not more than seven consultants in Scientific Management could be found).[3] Engel became a consultant for the Danish branch of ASEA and Carl Lund Fabriker. We have detailed information the organizational changes that Engel introduced in 1917-1919 to the later factory. He emphasized the introduction of workflows with forms and statistical data, which is not surprising since the company had control of about 2,000 different product codes. Moreover there were detailed descriptions of the work functions of the company's sharp division of labor. In his work, Engel also made an effort to get create 'business spirit', which apparently was his complement to Taylor's ideas. Engel wrote that the organization has an important role to, "educate any of the participants in the company to have a common feeling ... just as in national feeling and home town sentiment there is a great unifying force in this 'Business Sentiment". This strengthening of business sentiment was also similar in Engel's description of the organization in Trådværket in 1915.

Engels consultancy was not particularly lucky with its activities. Apart from the two factories, there was apparently no other Danish companies who wanted to use Scientific Management. Engel therefore had time to practice Taylor's ideas for himself. Due to the lack of work for the industry, he went instead into agriculture. He bought a large farm in North Zealand, where he conducted a running in accordance with the principles of Scientific Management.(as it moreover happened later in agriculture in Finland).[4] The farm was managed after the best practices, which included systematic operational plans. He was ahead technically, and his farm was one of the first in the country which acquired a tractor.

Scientific Management after 1920

After 1920, in many countries the interest in the Scientific Management increased so much that there were national institutions established to promote it. Already in 1918 there was an institute established in Czechoslovakia and in the early 1920s a number of other European countries had created institutions and laboratories working with theoretical studies and surveys. Moreover, both national and international congresses were arranged where the ideas were being discussed.

In Denmark, however, Scientific Management remained quiet. Denmark was one of the few countries that not really accentuated itself.[5] The country had no institutions, neither practitioners nor researchers participating in international congresses. It was many years before anything happened in Denmark. But in the late 1920s new ideas came to Danish business leaders.[6] Now the hot fashion concept was referred to as 'rationalization',[7] a term which had not been used until that time.

In the early 1930s new management ideas came

3 Whitston 1997a, p 227.

4 Paul Devinat 1927, p. 75.

5 Denmark is one of the only countries that was not mentioned in a overview published by ILO in 1927. Devinat 1927, p. 50.

6 Mentioned 1929 in Tidsskrift for Industri, Socialt Tidsskrift and the article The new Denmark in a book.

7 Markussen 1988, p. 238.

through that time's highly profiled Bedaux method. The method was named after its French inventor, who marketed it from his headquarters in the U.S. through consultant offices in many countries. The method was marketed as a brand and was highlighted as the only one that could calculate the proper relationship between work and rest time.[8] In Denmark the method was introduced in textile factories in Brede and Silkeborg 1933-1934. At Silkeborg, it caused so much discontent among the workers that it resulted in one of major strikes of that time.

The real breakthrough for Scientific Management, however, never really took place until the late 1940s. It was most likely due to the enhanced cooperation in the workplace, which made comprehensive agreements possible. In particular, works councils were important in the negotiating system. Scientific Management came back to Trådværket in Middelfart. Now it was one of NKT's factories in Copenhagen which had been a pioneering company in terms of time studies and 'new' forms of wages. At the earliest, in 1965 it was again possible to discuss scientific management in Middelfart, long after it was introduced elsewhere in the Danish industry.

The objective preconditions for scientific management

In an analysis of t why the management theories like the Taylor-system take off, it would be natural to start by looking at the objective conditions. The many textbooks and reference works argue that the industrialization with machines and repetitive work was a prerequisite for Scientific Management. This explication is too simple. This type of work has always existed, for example among weavers in large and small workshops. Other factors must have also played a role. It is also mentioned that it was the size of the new industry, which meant that new management methods had to be used.[9] According to this theory there had, after the establishment of industrial enterprises, been transferred authority from the head in the same way than authority was transferred at the old craft work, but after a decade or two the workers felt themselves no longer in solidarity with the owner and managers, so new management methods needed to be established. This theory also does not seem to hold when looking at specific companies.

The new leadership forms could also have been due to the large factories being more complex.[10] It is hard to judge this statement, since in Denmark no systematic studies of the Danish industry organization have been preformed. It could be correct, if the companies were so large that the engineers had both the managerial and technical responsibility. Really, the power went from the foremen and to the planning engineers. Note that Engel was the first engineer at the factory and that he introduced Scientific Management, while a few additional engineers were hired. Note also that his successor stopped the new ideas, although he at one time had the whole ten engineers employed under him.

A fourth possible explanation could be that unskilled workers had to have a narrow and controlled environment to work from. Conversely workplaces dominated by skilled jobs could be easily controlled by the workers themselves, since it was not necessary to have a working office to explain the skilled workers what they had to do. Through their training, they had the background for themselves to perform the correct working methods. Qualification, however, was a problem in the U.S., where there was a shortage of skilled workers, so they had to introduce automation.[11] This could explain why the ideas of Scientific Management originated in the United States. But it does not explain why the ideas were later introduced in Europe in spite of the high proportion of skilled workers.

In the same context, I will propose that there was a reason of economic priorities. It could be that management believed that the relative cost of remuneration of labour (relative to the price of raw materials and other durable goods) was still so small that executives did not consider it worth an effort to streamline this part of the production. Management leaders thought, perhaps, that they could have greater economic benefits by improving the technical production than by improving the management systems. For example, Tuxen could as the new director of Trådværket use his knowledge of electric motors to achieve efficiencies through the introduction of electric traction, instead of the using the central steam engines and related cumbersome driving shafts. This meant large savings since each machine could have its own electric motor and the machines could be placed appropriately in relation to the production flow. However, it is only a tenuous theory, since there is very little basic research to build on.

We must note that in Denmark the time was not mature for Scientific Management, though the Danish

8 Layton 1974 and Christensen 1999.

9 Urwick & Brrech in 1994, p. 11.

10 Nelson 1995, p. 48; about the planning engineers see Humpreys 1986, p. 46.

11 Kjær Hansen 1919, p. 383.

conditions in productive business were in many ways dominated by large impersonal companies and unskilled, repetitive work. An explanation based on objective factors alone appears not to last.

The international pioneers

Why was Scientific Management a concept which Taylor's contemporaries (and certainly persons in the future) found to be so important? Denmark was obviously not the only country in the world where Taylor's ideas had attempted to be transferred from the U.S. Most industrialized countries followed the debate and sought to take advantage of the new theories. A survey in 1912 indicates that there had been experiments with 'labor saving management' in 32 locations in Europe and Japan.[12] France was one of the countries outside the U.S. with the strongest agitation for the use of Scientific Management. This is due to the effort of one person, Henry Le Chatelier. He had read about Taylor's ideas, and after a subsequent correspondence, he began to campaign for them.[13] He got the book "Shop Management" translated into French in 1907 and then he began to introduce the ideas into practice in French companies. The system became a reality at the Renault factory in 1907-09 in which a rather un-radical version was very quickly introduced. This included careful written instructions of each function, the planning of the work made from a special department, tools controlled and maintained by the planning department, and the employees receiving a higher salary.[14]

In Sweden it is stated that at the factory Separator had already, in 1906, concluded on an agreement which had many features of Taylorist principles.[15] An introduction of Taylor's ideas in a more pure form was not made until after 1915.[16] In Germany another metallurgist marketed the ideas of scientific management, Professor Georg Schlesinger from the Royal Institute of Physics at Carlottenburg. A German translation of "Shop Management" appeared in 1904.[17] At German Bosch factories Taylor's ideas were introduced starting in 1907. It happened at the same gradual manner as was the case in Denmark.[18] Common to nearly all these actions is that the introduction happened in the iron industry and that the engineers behind it were specialists in metallurgy. Le Chatelier in France was the leading metallurgist in the country; he was an engineer and had been inspired by Taylor's methods to start *la Revue de métallurgie* in 1904 which became the leading journal of metallurgy in France; Le Chatelier was editor of for many years.[19] Finally, as mentioned, Walter Engels's work was of great importance, both in Germany for his work in iron industries and in Denmark where he became the country's leading expert, (in particular, he made many patents for iron manufacturing and processing and was later a professor in the subject at the technological university).

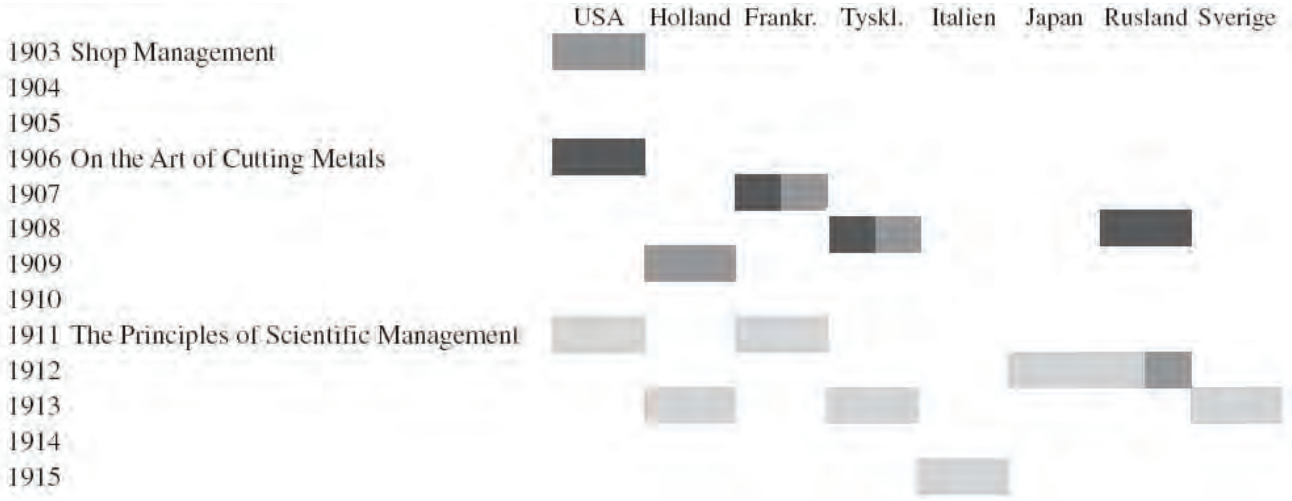
The high speed steel

The many people within the iron industry make it natural to hake a little story about 'high speed steel', which played an important role in the acceptance of Scientific Management. The world exhibition in Paris, in 1900, was where the world could behold the excellence of tomorrow's technology. A poet referred to the exhibition as, "the modern progress celebration for centuries".[20] In particular, there was great attention paid to technology from the United States, which at the time was the great technical innovator. One of the major events at the exhibition was the so-called high speed steel; at least for experts it was a real sensation. This technology had developed steel in a lathe that could run two to four times faster than people were accustomed to. Tremendous savings were ready for the iron industry around the world.

One of the two men behind the patented new steel was Taylor. He had be an engineer since 1882 and had been conducting experiments to develop the perfect lathe work. 400 tons of steel could be used for the 30-50.000 experiments, until the perfect steel was found. All possible combinations of composition, heat treatment, sharpening, and many more elements were tried. The alloy steel had 7.7% tungsten and 1.8% chromium, and the alloy was to be made in a completely careful and specified manner. In addition there were rules for its use so that the heat evolution would be kept under the temperature for steel melting. There were strict instructions on the rate lathes were to run, the cutting depth and the pressure force on the machine, and when there should be a switch to fresh steel. Following the presentation in Paris, Taylor described the method in the book "On the Art of Cutting Metals", published in 1906.[21]

It should be noted that such an effective tool not

12 Nelson 1995, p. 69, note 76.
13 Kanigel 1997, p. 402.
14 Humphreys 1986, pp. 55, 59, 65 and 79.
15 Johansson 1990, p. 45.
16 Jonsson 1981, p. 19.
17 Nelson 1992, p. 17 mentions 1904, but in library catalogues is has only been possible to me to verify the 1908 edition.
18 Homborg 1978, p. 183.
19 Humphreys 1986, p. 49; Kanigel 1997, p. 403 and Henry 2000.
20 Johannes V. Jensen.
21 Aitken 1960, p. 29.



The figure shows how the ideas of Taylor spread throughout different countries. The book about high speed steel, "On the Art of Cutting Metals", quickly broke through and was translated into many languages. On the other hand, "Shop Management", about management methods, was first recognized thanks to a book about quite another topic. When his book about Scientific Management was published in the USA, it went on to quick triumphal progress through the whole world; his ideas had broken through.

only had a technological side but also had an organizational impact on business. There had to be a new way to organize the work when there was a longer time between changing tools and when there was a smaller time to finalize a blank. The invention was created by scientific experimentation, and even a skilled person should slavishly follow the results of this scientific method. It was here at the exhibition that the world's metal experts saw Taylor's merits and some of them, including Engel,- were from then on advocates of his other ideas. The scientific approach to the technical matters was transferred to the workers and to management. The engineers were practical people who here saw new opportunities.[22] There was generally a great enthusiasm for the U.S. among technicians. They streamed into the country on training trips. In 1904 alone, around 1.500-2.000 engineers traveled from England to the U.S. to learn about new technologies.[23] Scientific management was one of those new innovations.

The right belief - faith can move mountains

It was with awe that Taylor was mentioned by the advocates of Scientific Management. It is therefore not surprising that many referred to the new form for management as synonymous with 'Taylorism', a term that has survived to our time. In our time, a more objective book-learned person can actually report that virtually none of Taylor's ideas were new. The use of time studies to measure production efficiency had already been used in the 1700s. In 1772-73 Johan Eric Norberg made measurements in Karlskrona in Sweden,[24] and about the same time the landowner CA Ehrensvärd measured the effectiveness of his villeins.[25] In the 1830s Charles Babbage did the same. He also had a scientific approach to the study of cost accounting, labor division, and specialization. In addition were a large number of individuals who in each of their fields have contributed to theories of leadership, for example Thomas More, Niccolo Machiavelli, James Steuart, Adam Smith, James Watt and Robert Owen, to name the most famous.[26]

When Taylor demonstrably has not developed all of these ideas on his own, then why is a whole world 100 years later still calling the rational management system by his name? A part of the explanation lies in the personal conditions he lived under. His many inventions and also the results from \his\ work of rationalization had made him a rich man.[27] He could arrange to retire in 1901 at the age of 45 years, but instead he devoted his time to developing and promoting his ideas. He surrounded himself with a number of talented people, who each in their own way supported him in a sort of team work.[28] Early on, the Norwegian-born mathematician Carl G. Barth came to work with Taylor, and later joined Henry L. Gannt and time study expert Sanford E. Thompson. In 1907 came Frank B. Gilbreth who had expertise

22 Aitken 1960, p. 16
23 Whitston 1997a, p. 209.
24 Jonsson 1981, p. 4.
25 Nyström 1987.
26 George 1972.
27 Nelson 1974, p. 483.
28 Nadworny 1955.

in the study of movement in work (a job his wife Lillian Gilbreth continued after his death). These pioneers of Scientific Management were each their own personalities[29] not puppets who danced after Taylor's will. Taylor, however, was the movement's charismatic and unifying center.

It was the people in this group that were accepted as consultants to introduce Scientific Management to the companies that wanted it (example of their consultations are measured in Nelson 1974, 488 f.). Consultants with a more pragmatic approach to work were virtually excluded from the consultants' group. Thus, the independent consultant Harrington Emerson became one of the 'enemies', while his more pragmatic approach did give results.[30] More discrete was Taylors' exclusion of Gilbreth even he was the driving force in organizing the Society for the Promotion of the Science of Management in 1910.[31] Taylors' goals were set high. Even when the French 'disciple' Le Chatelier wanted his son to become learned in the teachings of Taylor he was rejected. This was because his son had only a few months available. According to Taylor it would take years to get acquainted with the practical working conditions. It was necessary to have experience of practical work in order to later take into account the workers' situation, so they do not strike, Taylor argued, among other things.[32]

Thanks to his high speed steel Taylor acquired an idolized status. This status was automatically transferred to his work around the new management concepts. At a fairly late stage it was named 'Scientific Management' and it was a trademark, a 'brand'. After some official hearings in 1911 the system's reputation grew as it was made known in the wider community as an opportunity for major rationalization gains. This attitude in clearly expressed by Taylor's French disciple, Le Chatelier, who in 1914 writes, "Another force that will make Taylor's ideas to triumph is that Scientific Management in the eyes of its supporters, is a true religion, and as we know - faith can move mountains".[33] This prophetic statement explains why Taylor's name is still closely linked to the concept of Scientific Management, though the ideas are far from being original.

This interpretation is also consistent with the international spread of Taylor's written works. The first of his books, which was received internationally, was "On the Art of Cutting Metals". It was published in France the year after the U.S. release and in Germany and Russia two years later. However, the popularity of Taylor's ideas slowed down with his first book on Scientific Management, "Shop Management", published in 1903. It first appeared in France three years after its U.S. release and six years after in the Netherlands and Germany. By contrast, "The Principles of Scientific Management", its publication in the U.S. in 1911 was almost immediately followed by releases in many other countries. At this point, Taylor had gained advocates throughout the world. In France, it was published the same year, in Japan and Russia the following year, and in the third year it came into the Netherlands, Germany, and Sweden.[34]

Opposition from workers

One could imagine that a major reason for resistance the Scientific Management was due to resistance from the workers. Taylor himself said that the scientific system would actually make the trade union role in wage determination unnecessary, as Engel in Denmark was referred to have believed. Taylor would for many years emphasize that his system would not negatively affect workers. He underlined that there had not been strikes or labor struggles due to the introduction of his system. If there had been problems after the introduction of new management forms, it was caused by unlicensed advisers who had misunderstood his ideas. Taylor's claim remained until 1911 when workers used rationalization efforts in the state owned Watertown Arsenal.[35] Then the workers in the United States referred to these aspects, and in alliance with legislators, in 1915 time studies where banned from use when government spending on defense was involved. This decision was upheld every year for 33 years, until 1949. Similarly conflicts arose in several European companies which had been restructured according the new thoughts. The Renault factories in France experienced extensive

29 The charismatic and distinctive personalities of Frank and Lillian Gilbreth are shown by the books written by two of their children (one book is even filmed). Although it is a fictional family history their personalities clearly shine through (Gilbreth & Carey in 1969 and 1952). Taylor's personal circumstances are described in Kanigel 1997. See also Kakar 1970, Merkle 1980, Wrege & Greenwood 1991.

30 Nadworny 1955, p. 18; on perceptions see also Hansen 2000, p. 177.

31 Nadworny 1957, p. 26.

32 Humphreys 1986, p. 66.

33 Humphreys 1986, p. 76. (translated from Danish).

34 The specification is from information from Samuel C. Williams Library. They had to be handled with a little reservation; the year mentioned for Sweden was probably wrong.

35 Aitken 1960, 135; Nadworny 1955, p. 84.

strikes against time studies in 1912 and 1913 (Taylor denounced the methods in the factories because they were not fully consistent with his ideas).[36] Due to a similar dissatisfaction with the composition determination, there was a great strike by the German Bosch factories' workers in 1913[37] and in Sweden there was a conflict at Svenska Stålpressningsaktiebolaget in Olofström.[38]

On the other hand, it is interesting that several authors mentioned that remarkably enough– Taylor's ideas did not have the same impact in England as it did in the U.S. His books could be read from the very first day. His ideas were studied but were not received with the same enthusiasm as in the rest of the world.[39] The reason for the lack of enthusiasm is partly explained by the fact that England had emerged with a strong interest and research in industrial psychology. Conditions had not the narrow economic objectives as did Scientific Management.[40] This more work-friendly attitude went later in symbiosis with Taylor's ideas, when the managers wanted workers to accept new reforms. In this way Scientific Management came to cover a concept with new content.[41] Recent research seems to show that knowledge of Taylor's ideas were not so prevalent in England as in other European countries.[42] This was in spite of the fact that the first time studies began in 1911, at the same time as the mentioned Danish introduction.[43]

In Denmark, have the introduction of the system created some conflict with the worker? In Trådværket, Middelfart, during the period where Engel introduced the new ideas, the factory experienced three major labor battles.

The first conflict arose in 1912. The plant would introduce a new tool to sharpen wire that would help the workers in their piece-rate work. All agreed that the new machines would be beneficially and would replace work originally was done manually with a file. But who would have the benefits from the newly introduced technology? Should workers have less in piece-rate, or should they keep the old rate? The workers refused to go down into their piece-rate, which forced the factory to give up the new machines. Then the workers insisted on having the new machines, and after the workers had threatened to buy the machines themselves, both sides finally found a compromise. It cannot be said of this conflict, as of the others, that there was any direct connection to the Scientific Management, despite its interesting issue.

The second labor battle involved the dockers who worked for the company. In 1913 there was a port built which connected to the factory, and there was a disagreement about the work of loading and unloading ships. It was not possible to make an agreement on the compensation for serving new unloading equipment and whether the foreman should continue to manage the dock workers. The conflict ran for almost a year, and the port could not be used during this period. There cannot be any relationship observed between the conflict and the introduction of new management ideas within the factory. The conflict was a traditional labor struggle that dock workers, for instance, won.

The third conflict also occurred in 1913. At a new department, five workers refused to work with a specific winch, so they were fired. The event created some unrest at the factory, and it grew into a larger conflict. The conflict did not break out, however, because the whole part of the factory burned down three days later. Some months later, the Arbitration Court made a decision about the conflict. The workers were condemned to having to perform the incomplete, but now outdated, work. Even in this conflict, there appears to be no direct connection to Scientific Management. The workers argument was that the lifting power was dangerous to use because there were teeth missing from a toothed wheels.

While there apparently had not been any protests in Middelfart against the new ideas, one could imagine that there had been a resistance within the labor movement at the central level. If nothing else, the unionists could have heard about negative aspects from other countries, but this does not appear to be the case. During this period there has been no clearly articulated opposition from workers. On the contrary the Danish labour movement was pretty uninvolved. This is mentioned in a book by C.V. Bramsnæs, the later Social Democratic Finance Minister and Director of the National Bank, which he released in 1917 after having lectured on the subject in the National Economic Association. "The Taylor system" was the title, where he reviewed the American theories of

36 Layton 1974, p. 380 and Nelson 1992, p. 20.
37 Homburg 1978.
38 Johansson 1990, p. 20.
39 Cf. Devinat 1927, p. 25, Hansen 2000, p. 186, Whitston 1997 a and 1997 b and Urwick & Breach 1994, p. 88. Urwick & Breach is a literary study. It is possible to think that Scientific Management in practice was practiced in businesses around the UK. If they were not mentioned in books or articles Urwick & Breach would not be aware of their existence.
40 Kreis 1995.
41 Devinat 1927, p. 26.
42 Whitston 1997b.
43 Whitston 1997a, p. 223.

rational factory management. Bramsnæs were largely positive about Taylor's ideas. He stated, "The task in the future must be to find forms for uses of the good principles of Taylor and other similar systems in such a way that will benefit the entire society - not just for individual parts of it."[44] This book contained only one reference to Danish conditions in a single note which stated that Taylor's ideas were introduced in Middelfart. Apart from this, there were only references to American books.
It can be concluded that the lack of impact of Taylor's ideas in Denmark at least not was due to massive opposition from the unions.

Business managers attitude

Engel was, no doubt, disappointed after having made his lectures. There were no other business leaders who wanted to use the presented ideas. The only the before mentioned two jobs resulted. When the introduction was not a success, the reason was rather an aversion from the Danish business leaders. Engels successor as manager in Middelfart was one of those people who did not think that the new ideas could be used. An even bigger failure for Engel was when, in 1918, he proposed to the Association of Manufacturers in Iron Industry in Copenhagen and to another organization the introduction of a techno-economic institute, after a model from the Swedish Iron Office. The main activity would have been on Scientific Management in the style of Frederick W. Taylor Cooperators in the U.S. The matter was treated sympathetically by a joint committee of the two associations, but there were some concerns that "it could not be avoided that Engel, as a theorist, made projects which may be said to be unworkable in practice", as one big business man said in an unofficial occasion.[45]

Engel tried hard to convince the business people about the methods suitability and thereby the justification of the institute. He was fully convinced that he, through a time study, could settle a dispute about a piece-rate by finding how much there could and should be performed by a job. Even after the refusal he offered to make a time study "without any compensation" to show how much benefit both the unions and the factory could receive from Taylor's ideas. It was yet another rejection. The time was not ripe. Even business leaders were opposed to the new ideas.

Consequences in the short term

It is difficult to decide how large of an influence Taylor's work really had. One hint can be found by looking at the results of the companies in which his ideas were introduced. Trådværket was the only Danish example from the early period.[46]

It appears indeed that there were very few companies throughout the world where the system was even introduced as a whole. An inventory from 1912 showed, admittedly optimistic, that there were 212 companies worldwide, 169 of which were in the U.S. A more critical look at these attempts for introduction when applied to the tough criteria that Taylor himself put on complete implementation cause the number of successful introductions to be considerably reduced. R.F. Hoxie mentions that in 1916 no place has fully introduced Taylor's system when compared to the tables as presented in "Shop Management".[47] The researcher Daniel Nelson would later find a few companies that meet his criteria for a perfect system:

- Preceding technical and organizational improvements (better machinery, purchasing system, accounting system, storage etc)
- Planning Department
- Functional foremen
- Time Studies
- Wage system

Most of the surveyed companies had seen improvements in three to four of those points. To what extent there were companies which met all points would be of broader discussion. The third point, functional foremen, especially lacked. For businesses with a known description of their organizational relationship only five or six, worldwoide, had implemented a complete Taylor system.[48]

Conclusion

F.W. Taylor's ideas about Scientific Management had in fact only a limited impact on management practices before 1920. Worldwide, the system was only successfully implemented in maybe five or six organizations. In Denmark, an early introduction of the system took place at the NKT cable factory in Middelfart. Over a ten-year period, from 1905 to 1915 the new scientific management principles were gradually adopted. However, a change in management led to parts of the system, such as the time-study based wage principle, being abandoned. Half a century later the 'new' ideas were reinstalled in the organization.

44 Bramsnæs 1917.

45 Petersen 1990 has a similar history of the failure of two naval officers that had to resign.

46 A similar discussion about the impact in Sweden is made by Berggren, 1981.

47 Hoxie 1916, reported by Nelson in 1995, p. 69.

48 Nelson 1995, p. 70 and Nelson 1974, p. 489. This is discussed in Fleischman 2000, p. 604, 622-623.

Only a little research has been done on work organizations from a historic perspective. Also, while many general studies of management philosophy have been carried out, little is known about management practices seen from the shop floor reality. Based on the existing knowledge, it seems that the failing break-through of Scientific Management in its first period were not, as often suggested, caused by resistance from the labour unions, who at that time hardly knew about the ideas. In the contrary, the resistance came from conservative oriented top managers who often put the brakes on the introduction of new management thoughts and systems.

It would be wrong to say that new management methods automatically emerge as a consequence of structural, technological, or competitive necessity. At the NKT plant, at least, the introduction and implementation of Scientific Management were carried through by the personal enthusiasm of a factory manager who happened to be enticed and exited by the new Tayloristic thoughts. It was this excitement in itself that became influential, and not the specifics of the new methods, as most parts of these were known and developed by others already in the preceding century. The most important source of influence was the charisma of Taylor who became the central figure due to his introduction of high speed steel in 1900 as an almost political or religious movement with an overweight in the iron business.

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