Governing by carrot and stick: A genealogy of the incentive
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The incentive first made its appearance in a discussion among American engineers over the benefits and pitfalls of piece wages in industry in the 1880s and 1890s. Of course, the actual use of this specific method of remuneration was not born out of a late nineteenth-century debate. Karl Marx, for one, dated the practice of paying by the piece back to the fourteenth century, when it was mentioned in opposition to time wages in English and French labor statutes. According to Marx, both wage forms served the same basic purpose of exploiting the power of labor. But of the two, piece wages were more in harmony with capitalist production because they helped to lengthen the working day and reduce the wages paid for labor (Marx 1992 [1867], 698).

The mere existence of a wage practice in industry, however, does not make for a veritable problem of knowledge and governance. A governmental problem comes into being when certain perceived difficulties are brought to a level of reflection; a level of reflection, moreover, that eventually results in a ‘rationalized’ program for further action. Marx would certainly be the last to participate in such an attempt to improve wage methods in industry. For the constitution of the problem that became central to the first incentive-infused governmentality, we turn from the most famous critic of capitalism to a new professional group that
earned its money at the interface of labor and capital: the mechanical engineers. It was among the members of the American Society of Mechanical Engineers that existing wage practices were turned into a novel technical problem of worker motivation and monetary inducement.

The engineers did this by bringing the shortcomings of current wage methods to the fore. According to the engineers, both day rates and ordinary piece rates suffered from the same motivational defect. Under a system of day wages, workers soon learned that a surplus of effort did not pay off. An ambitious worker would not be motivated to exert herself when the wage she received was based on the number of hours worked. Even a worker of goodwill and talent could become lazy upon discovering that his wage remained the same no matter how hard he worked. A piecework system seemed to offer a solution to this problem, because it appeared to provide a direct link between productivity and pay. On closer inspection, however, this was not necessarily the case. The establishment of a robust relation between productivity and reward was seriously hampered by intermittent changes in the piece rates. When employers thought that labor costs were rising too fast, they often responded by cutting the piece rate received by the workers. What was an understandable response from the perspective of short-term cost containment was a bad response in regard to the long-term motivation of employees. For who would be tempted to work hard, if a rise in output eventually led to a wage cut? Again, the most ambitious workers would eventually stop exerting themselves after piece rates had been cut multiple times. Thus, the method of working at piece rate—at first thought of as a solution to the problem of day wages—was equally flawed in terms of worker motivation (Taylor 1895, 861–864; Drury 1922, 53–55).

Although this so-called wage problem seemed a local and technical one, the consulting engineers linked it to the broader social problem of industrial conflict. None of them shared Marx’s vision of the necessary collapse of capitalism, but they did capitalize on their potential clients’ fears of labor turmoil due to a large number of strikes in the 1880s (Nelson 1995, 52). In their gloomy picture of the future, the need for wage cuts and the use of pressure toward greater output would lead to oppositional force by the workers. The resistance to managerial intervention by workers and their representatives would in turn provoke an even harsher response from management and so forth. In the words of Frederick Taylor, the most famous member of the Society, there “begins a war, generally an amicable war, but none the less a war, between the workmen and the management” (1895, 863). The amicable war could easily turn to less friendly confrontations and, with tensions
mounting, lead to the collapse of industrial organizations. To prevent such an event from happening, both employers and employees needed to transcend their initial antagonism and embrace a management system that acknowledged the need for good relations between managers and workers. The mutual recognition that these good relations were necessary, however, was thwarted by a very narrow conception of what acting out of self-interest entailed. For, if one thing marked both labor unions and employers’ associations, it was their unthinking selfishness. As one of the engineers framed the issue: both sides demand as much as possible for oneself while at the same time blocking the other’s demands and “both are formed with the idea of using force only” (Gantt 1919, 26). The conflicts that would follow might lead to short-term victories but not to a satisfactory and permanent state of peace. If industry was to “progress from an era of force to one of equity”, Gantt declared in epochal terms, then the adversaries should look for a new state of industrial equilibrium founded on an “intelligent selfishness […] which shares the benefits equitably among those helping to obtain them” (1919, 111).

The link between a potential crisis of capitalism and the wage problem might seem far-fetched. Yet the strategy of the engineers fits quite well with the way scientists of that period responded to the vast socio-economic changes in America. As Dorothy Ross (1991, 26–30) argued in her comprehensive account of the origins of American social science, the work of contemporary scientists and intellectuals could only be understood in the contexts of the experience of civil war, the sense of rapid industrialization and the awareness of class conflict in Europe. American scientists responded in two different ways to the possibility of historical transformation. At first, many scientists sought refuge in what Ross calls ‘the exceptionalist ideal’. They held that America was immune to European-style class conflict because it was built on sound constitutional principles. Societal harmony was therefore guaranteed from the moment these principles were institutionalized in the late eighteenth century. Once social conflict became more manifest, however, scientists from different disciplines had to reconsider their earlier stance of flagrant denial. To that end they proffered a second remedy: scientific expertise. If it was no longer possible to deny the existence of structural conflicts in America, then it was time to put the results of science into practice and opt for piecemeal social transformation guided by experts trained in the social sciences. The incentive was no exception to that rule: “Within the frameworks of scientific management and behavioral psychology, incentives were understood as an instrument in the hands of powerful experts useful for managing and directing people’s behavior to achieve certain social purposes” (Grant 2002, 130). Behavioral
psychology will not be dealt with here, but I will articulate, in more detail, the development of a new form of managerial expertise to cope with the industrial problems of that period.

In the late nineteenth century, the mechanical engineers were determined to show that the discord that characterized modern capitalism was but a temporary problem that could be solved by hiring knowledgeable experts. In fact, they thought that the broader problem of industrial conflict was due to the smaller technical problem of establishing a clear link between the number of products delivered and the amount of pay received. If a balance could be found in which the use of monetary incentives to increase production did not result in a sharp increase in wages, there would be no need for future wage cuts, which would take the sting out of the conflict. The most important stake in the debate was to explain the advantages of one method of remuneration over another in terms of its motivational characteristics and promised increase in output. And this is where incentives came in. Not yet heavily theorized, ‘incentive’ was introduced as a motivational term, synonymous with inducement, that had a strong monetary connotation. There were two sides to the engineering of incentives. On the one hand, it was connected to a question about the distinctive features of the working subject: What actually drove workers to give their best? The engineers thus turned the worker into a new object of knowledge. On the other hand, the question of worker characteristics was only part of a larger technical problem regarding the governing of the labor force. As engineers developed different techniques of remuneration to stimulate worker performance, each claimed to have found a continuous labor incentive that would enhance productivity while simultaneously eliminating the source of labor conflicts. Along the way, wage incentive systems became integrated in a more sophisticated technology of power.

3.1 Three wage incentive plans

The first articles on wage incentives were published in the *Transaction of the American Society of Mechanical Engineers*, which was mainly dominated by technical debates over machine design. Only after a lecture delivered to the society by Henry Towne in 1886 did some members of this society begin to address problems of industrial management. In his lecture, “The Engineer as Economist”, Towne summoned his fellow members to pay more attention to the proper
government of factory workers. The art of shop management and the science of engineering were deemed equally important for industry. But, whereas the latter already had its own literature, journals and associations, Towne observed, the former “is unorganized, is almost without literature, has no organ or medium for the interchange of experience, and is without association or organization of any kind” (1886, 429). This asymmetry was especially salient in the current industrial period. For although the use of heavy machines in industry had increased rapidly in the second half of the nineteenth century, the management techniques used to steer the workers in the right direction were still in the pipeline. So long as the methods of worker management remained primitive, the economic benefits of technological improvements would be seriously tempered (Aitken 1985, 35–37). It was up to the engineers to fill the gap by developing a new body of knowledge on the management of labor. To set an example, Towne concluded his lecture on the engineer as economist with a graph that showed how the labor costs for a certain product had diminished over time. Certainly, part of the positive results could be explained by more experienced workers who produced a larger output with better equipment. Despite this explanation, Towne declared, “there remains a large portion of the reduction which, to the writer’s knowledge, is fairly attributable to the operations of the peculiar piece-work system adopted” (1886, 432).

The details of this system were revealed three years later in a paper on profit sharing. The basic idea was simple: when laborers shared in the profits of their company, they would be induced to contribute as much as possible to production. Though it sounded like a gentle way to stimulate workers, the opponents of profit sharing were not convinced. In practice, they said, laborers would receive an increase in income for fluctuations in profit they were not responsible for. Increased productivity might contribute to a higher profit but so did an economic boom or good investment choices made by the executives. To accommodate such concerns, Towne developed an alternative system called ‘gain-sharing’ in which the contribution of laborers to increased production could be determined. All that was required for gain-sharing to work was “an accurate knowledge of the present cost of product” (Towne 1889, 603). Bookkeepers were therefore in need of an administrative system in which production costs could be divided into factors within the laborer’s sphere of influence and factors where no such influence was possible. In this way it was easy to determine whether the workers were really responsible for a rise in profits. Only for the economical use of material and more efficient working methods—or ‘gain’ as Towne dubbed it—did the laborers receive a share in the firm’s profits. When they managed to save on the cost of
their product, each worker received a special “dividend envelope” at the end of the year (Towne 1889, 606). For Towne, the paper on gain-sharing was more than a theoretical plea for one specific method of remuneration. As president of the Yale and Towne Manufacturing Company, he had introduced the system to his own workers some years before and could personally vouch for its practicality and effectiveness.

Two years later, in 1891, Frederick Halsey presented a second solution to the wage problem. His “Premium Plan of Paying for Labor” was published in response to a long list of objections against profit sharing, which even Towne’s more advanced method of gain-sharing could not meet. One of the objections had to do with the remoteness of the reward. Under a system of yearly bonuses for saving on production costs, the “incentive cannot be as great […] as under one which pays out the extra earnings week by week” (Halsey 1891, 758). Apparently, the worker was more motivated to work when the monetary gratification was immediate and not at some time in the distant future. Furthermore, Halsey doubted whether gain-sharing really induced the worker to be more efficient. Here, the main issue was not the relative strength of incentives in relation to time but the relation between individual effort and group reward: “An active, energetic workman cannot have the same incentive to increased exertion under a system which divides the results of his efforts among a dozen lazy fellows at his side that he would have under one in which his earnings depend on himself alone…” (Halsey 1891, 757). As the contribution of an individual worker to the overall yearly profit was but small, the content of the dividend envelope depended crucially on the inclination of her colleagues to exert themselves. The challenge for Halsey was therefore to develop a system of incentives in which the lack of individuality and the remoteness of the reward in previous wage systems could be adequately addressed. A key idea of his premium plan was to pay for labor in two separate parts. Workers would receive a fixed, daily wage for a fixed amount of work, which was calculated on the basis of past productivity. In addition, each worker would also be able to earn a flexible premium on top of his daily wage, based on the number of production hours he managed to save. This flexible or premium rate was modest so that the rise in labor costs would not be too sharp and no future wage cuts would be required (Drury 1922, 64–67). Because the bonus was based on individual production and distributed on a frequent basis, Halsey believed he had found a better wage incentive system than had the engineers before him. When it came to the exact determination of these rates, he declared that “nothing but good sense and judgment can decide in any case” (Halsey 1891, 760).
The third and final major wage incentive system was presented to the mechanical engineers by Frederick Taylor. According to Taylor, there was one crucial flaw in all earlier wage methods. The emphasis on individual or collective initiative in gain-sharing as well as in the premium plan made them sound agreeable to the workers, but it was also the plans’ main weakness. Ordinary management systems of “initiative and incentive”, as Taylor framed them, identified the task of managers as that of stimulating creativity and willingness to work hard by offering laborers a financial reward (1998 [1911], 14). In doing so, these systems left the choice of the most efficient method of working up to the laborer or lower foreman. They assumed that employees on the shop floor were the most capable of determining the best way to do the job—an assumption Taylor found utterly unwarranted. The results of industrial experiments he had conducted earlier showed that the choice over working methods could best be left to science, not to traditional rules of thumb “handed down […] by word of mouth” (1998, 12).

As befits the pretensions of scientific management, Taylor did not settle for Halsey’s “good sense and judgment” in matters of monetary incentives for workers:

The exact percentage by which the wages must be increased in order to make them work to their maximum is not a subject to be theorized over, settled by boards of directors sitting in solemn conclave, nor voted upon by trade unions. It is a fact inherent in human nature and has only been determined through the slow and difficult process of trial and error (1912, 25).

At Midvale, Taylor tried to determine the exact price of worker docility in a series of wage experiments. In each of these experiments a small group of workers was offered a premium for following Taylor’s instructions; some groups received a premium of 15 percent, while others were offered up to 35 percent above their current wage. After six months, the workers were asked whether they preferred to accept the experimental conditions as permanent or to return to the old wage conditions. The differences in decision patterns between the groups informed Taylor about how much it would take for laborers to overcome the pain of strict obedience and to work at a much higher speed than before. Although he admitted that the actual percentage was dependent on the type of work performed, he found that wages should at least be 35 percent above average to induce workers to accept the experimental conditions as permanent (Kanigel 2000, 212–213).
However, inducement alone was not enough. A proper wage system needed to ensure that working below standard was practically impossible. To make it do so, Taylor devised a second piece rate for workers who did not accomplish the task at hand. This rate was so low that the job became onerous for workers who failed to complete the task in the specified amount of time. In fact, the differential piece rate proposed was at least as much a negative stimulus as a positive one—a punishment for all laborers who were either unwilling or unable to work at the pace that Taylor had shown to be possible (Taylor 1895, 873; Aitken 1985, 37).

Despite the fact that Taylor developed his own wage incentive plan, it is somewhat peculiar for him to present the system of differential piece rates as a contribution to the debate about the wage problem. For even though he shared with his fellow engineers a preference for the use of monetary incentives as a stimulus to production, he certainly did not embrace their reduction of industrial management to the design of wages methods:

Under the ordinary type of management the necessity for offering the workman a special inducement has come to be so generally recognized that a large proportion of those most interested in the subject look upon the adoption of some one of the modern schemes for paying men […] as practically the whole system of management. Under scientific management, however, the particular pay system which is adopted is merely one of the subordinate elements (Taylor 1998, 14).

The incentive was thus incorporated into scientific management, but its position changed significantly. For the introduction of a suitable method of remuneration was only the final stage in a whole series of substantial changes to shop floor production. What was presented as a contribution to the current debate among mechanical engineers over proper wage techniques was thus actually an attempt to shift the debate in another direction.

3.2 Taylor and task management

Before Taylor wrote his seminal *Principles of Scientific Management* (1911), he had a long and successful career at the Midvale Steel Company in Philadelphia. From a low-rank position as laborer, he worked his way up to become a gang boss, a foreman and, finally, the chief engineer (Drury 1922, 118–119). Taylor's early
experiences convinced him of the fact that many workers only pretended to work hard and even deliberately tried to limit their daily output. When he was promoted to the position of foreman in 1882, Taylor began to experiment with work methods to counteract this systematic ‘soldiering’ among his workers. These methods would later become the hallmark of scientific management. Taylor’s objectives were to determine the exact tasks that workers were to accomplish as well as the amount of time it should take. As a preliminary step, every complex task was broken down to the level of simple physical movements. Deconstructed in this way, the study of motion revealed that the simple act of assembling two parts, for instance, consisted of the following basic hand gestures: move your empty right hand to reach for an object; grasp the object with your right hand; transport it by moving your right arm toward your left hand; turn both hands to the correct position; then put the two pieces together (figure 1). When reduction to the level of basic movements was completed, the next step was to decide which movements were strictly necessary for the task at hand and which could be either skipped or assigned to another task. In most cases job analysis led to the omission of all nonrepetitive elements until the bare essence of a task—a few movements repeated over and over again—was reached. Once the essential motions for the task had been established, a time study could be conducted. For that final step one only needed a good worker and a stopwatch. The time required to accomplish the task at hand was a combination of the time it took a machine to complete an operation and the time it took the laborer to handle the machine, plus some additional time for unforeseen events (Drury 1922, 57–61).

Figure 1. Film frames of a motion study, depicting the essential motions of a task (Lowry, Maynard and Stegemerten 1940, 78–79).
For daily life in the factory, adherence to the principles of scientific management meant that detailed instruction cards describing the best working method replaced the traditional rules of thumb. The results of time and motion studies were written down and communicated to the workers in order to enhance their productivity. In this way every worker knew what he or she had to do, how to do it and in what period of time. With the instruction cards as pièce de résistance of scientific management, Taylor thought he had solved the wage problem—not because he had found a method of remuneration that kept the development of wages in check, but because he had discovered a way to determine, once and for all, the right tempo for each task. As it was impossible to work much faster than the pace discovered by mechanical engineers, the fear of a future wage cuts should simply evaporate. Nevertheless, it was still possible to work slower than the standard. Here, the question of incentives returned. For it remained necessary to align the interest of the workforce with that of the company—even after Taylor had done his job.

3.3 Task and bonus at Bethlehem Steel

As chief engineer at Midvale, Taylor had been allowed to experiment with workers and working methods. After Midvale, however, he earned his income from advising the managers and owners of other factories and time was much more scarce in consultancy practice. His clients often valued quick results over long-term promises, and they sometimes explicitly demanded the immediate introduction of piece rates (Nelson 1995, 74–76). The method of differential piece rates proved difficult to implement in practice. The main obstacle for introducing Taylor’s system of incentives was its explicit dependence on all kinds of preliminary steps. A proper setting of the piece rates could only be accomplished when written instruction cards gave the laborer an exact idea of the task. This task, in turn, had to be based on the results of scientific inquiry. Time and motion studies required a substantial transformation on the shop floor: A lack of order had to make way for a clever rearrangement of the machines to ensure the proper flow of men and materials. In addition, the ideal speed of the machines had to be determined to ensure their optimal output and preservation.

The practical difficulties of performing these preliminary steps became evident during Taylor’s consultancy work for Bethlehem Steel Company between
1898 and 1901. Although the changes mentioned above were well underway after two years, there was as yet little improvement in the actual output of the workers. The explanation for the lack of a substantial increase in the average monthly production came from one of Taylor’s first students and collaborators. Like so many management theorists of the time, Henry Gantt was a mechanical engineer by profession. Educated at the Stevens Institute of Technology and The Johns Hopkins University in the 1870s, he first came into contact with scientific management while working at Midvale under Frederick Taylor’s wings. Gantt began his career by solving engineering problems. For example, his first job was that of simplifying the calculations of the proper speed for cutting metal (Kanigel 2000, 237–38). Questions of management came to dominate his writings and consultancy practice only from the late 1890s onward.

Gantt came to Bethlehem Steel at his former mentor’s request, and he developed his own management system on the basis of his experiences there. His explanation for the overall lack of progress was simple. The exclusive attention to the conditions under which a perfect system of incentives could be implemented had led to the total neglect of securing the workers’ cooperation in the meantime (Kanigel 2000, 351–353). Immediate action was therefore required for he “felt that we should not wait for perfection, but should offer the workmen additional pay in some manner that would not interfere with the ultimate adoption of the differential piece-rate system” (Gantt 1919, 107). Thus came a first, crude version of Gantt’s task and bonus system into being. In this system, a worker was paid a fixed wage with an extra sum of fifty cents when he completed the daily task. Similarly, the foreman received a bonus for each and every worker who managed to earn a bonus. Later, the bonus system was refined to accommodate a weakness in the first version: Gantt found that “after the men had earned their bonus there was no further incentive” for them to continue working hard for the rest of their shift (1919, 114–115). To give them a continuous incentive, the bonus for workers was now calculated on the basis of their success in saving on production time. For similar reasons, the foreman received an additional bonus only when all workers made theirs in order to keep him interested until the last and most inferior workers had been brought up to the standard.

The results were positive. Just two months after the additional payments had been established, the assistant superintendent observed that the morale of both workers and foremen had significantly improved. In a report written to his superior, he emphasized the beneficial effect of the new wage method: “It is only by the introduction of this ‘bonus’ plan that we have had furnished the automatic
incentive for men to work up to their capacity and to obtain from the machines
the product which they are capable of turning out” (Gantt 1919, 109). Though
the wish to offer a direct stimulus to production was the reason for introducing
the task and bonus system prior to the installment of a perfect wage method,
the system also had indirect effects that were equally important. One benefit
of introducing the task and bonus system before the differential piece rate was
that it guaranteed a fixed day wage and therefore “reassure[d] a labor force and
facilitate[d] the transfer of a shop onto scientifically set piece rates” (Jones 1916,
279). Another benefit was that the automatic incentive removed the “constant
necessity for driving the men” so that the foremen now had more time and energy
to assist the workers whenever it was necessary (Gantt 1919, 109).

The latter was no small step for industrial organizations. According to
Gantt, the basic management problem within modern factories was the foremen’s
lack of knowledge in regard to dealing with their subordinates. The increase of
scale in American industry made it necessary to split the factory into different
departments “each directed by a foreman, who, in many cases, has had no training
in management, and often has no capacity for it” (Gantt 1919, 22). In due time, the
foreman became overworked because he was unable to live up to the expectations
from higher executive personnel. His replacement by a new foreman did not really
solve the problem, for the latter was just as unable to cope with the problems
of modern shop floor management. When the expenses rose due to the lack of
efficient managerial control, the real problem was often overlooked. It seemed that
the piece rates of factory workers were to blame; thus, an overall reduction of their
wages was perceived as the only viable solution. This in turn disrupted the workers’
confidence in management’s ability to secure stable wage conditions and fostered
their malcontent. In light of this chain of events, the transition from driving to
assisting the workers, made possible by the automatic wage incentive, was crucial
for breaking the spiral of antagonism between management and worker.

3.4 Gantt’s practice of charting human performance

In itself the task and bonus system was not that original, nor did Gantt lay claim
to originality. What makes Gantt’s contribution innovative was the fact that he
integrated the incentive into a more encompassing management program with
which one could target all layers of the organization. He did so by way of a series
of charts on which different facets of the production process could be drawn. To keep track of the human and nonhuman performance on the shop floor, foremen could draw Man Record Charts and Machine Record Charts. Layout Charts provided a visualization of the work planned for the coming period so as to ensure that all activities were geared to one another. Progress Charts, which were periodic extractions of information from all the other charts, informed the executives about whether a plan thought out by management was being properly executed. With the help of that visual demonstration of the efficiency of the employees, management could transform work conditions as necessary in order to enhance shop floor performance and could be held accountable for the (lack of) positive results (Alexander 2008, 90–92). With the design of the Gantt charts we leave the narrow discussion over wage formulas behind and witness how incentives became embedded in a more sophisticated technique of power.

Although each of these charts highlighted a specific feature of the production process, they all contributed to the production and circulation of facts within the organization. According to Wallace Clark, Gantt’s student and another engineer turned management consultant, there was a “desire on the part of the managers and owners of industrial plants to get at the facts in regard to the operation of their industries” (1942 [1922], viii). The Gantt chart fulfilled that desire. As a new method of visualization it could play its part in “getting at the facts in any situation, and in presenting those facts so that they will be understood in relation to time” (Clark 1942, x). The question of the production and circulation of facts in industrial firms can be broken down into three smaller questions. What sort of a thing is the Gantt chart, and how do you draw it? What kind of knowledge is provided by these charts? What kind of managerial leverage and employee incentives do Gantt charts provide when it comes to the transformation of industrial practices? I will focus on the charting of human labor as it is most closely related to the engineering of incentives\textsuperscript{13}.

The purpose of a Man Record Chart was relatively clear—namely, it was to “show whether or not a man does a day’s work and, if not, the reason why” (Clark 1942, 27). Gantt elaborated on its use in several articles on industrial management in The Engineering Magazine and brought his ideas together in Work, Wages, and Profits (1910). He proposed to draw the daily performance of employees on a chart. The first thing to do was to give every single individual his or her own row. Each row was then divided into seven columns that represented the days of the week. Gantt’s initial proposal was to use different colors and marks to visualize the performance of the workers. The area of the daily column would be colored black when a worker
earned a bonus and red when the worker did not earn a bonus. A black cross indicated that the worker chose day work instead of piece work, and a red cross meant that the worker was absent that day. The result would be a sheet colored with red and black columns and crosses (see front and back covers). Although the chart showed whether employees completed their day’s work or not, its indication of the reasons why they failed to complete their tasks was still rudimentary.

Clark wrote an accessible and widely translated introduction to the practice of drawing charts. In *The Gantt Chart: A Working Tool for Management* (1922) he offered a step-by-step manual for drawing several types of charts regarding different parts and phases of production. Clark proposed to change the colors and crosses for lines that would represent the performance of the workers. Each of the columns or daily spaces now represented the amount of work that a worker should accomplish that day. Imagine a foreman who estimated that a good worker should be able to cut fifty pieces of metal a day. When the latter managed to complete the daily task on Monday, the foreman drew a light line in Monday’s column, which filled the entire space. When the same worker failed to complete the task the next day, producing forty pieces instead of fifty, the line was drawn through only 80 percent of the width of Tuesday’s column. By dedicating himself to such a routine of drawing, the foreman got a clear impression of the efficiency of those who worked in his department.

Yet in itself, the representation of the failures to reach a given target—in columns, with uncompleted lines—only informed the foreman that something had gone astray. It failed to tell him where the problem was located. Therefore, the foreman had to visit the shop floor to find out what had happened every time there was a gap between work expected and work delivered. To make the visual representations of delays more meaningful, the possible reasons for a delay were grouped into a number of classes. Each class had its own specific symbol such that the foreman had only to fill in the appropriate symbol in the portion of the daily space left open. The letter “G”, for instance, made clear that the delay was due to a “green” worker, that is, a machine operator who lacked manual dexterity because he or she was inexperienced (figure 2). Likewise, the delay caused by the inadequate supply or quality of the tools required for the job was represented by the letter “T” for “tool troubles”.

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Figure 2. Example of how a delay caused by a ‘green worker’ was represented on a Man Record Chart (Clark 1942, 29).
At the end of the week, the foreman drew up the balance sheet. After he added the number of pieces produced by a worker over the preceding days, he would draw a somewhat heavier line just beneath the daily lines for that worker. As the men were listed one below the other and grouped together by the name of the sub-foreman they worked under, it was now easy for the foreman to see, at a single glance, which individuals were the most productive and which individuals the least. Even if some of the reasons were beyond their control, the length of the cumulative lines at least revealed the relative strength of the workers to cope with the problems that crossed their paths. That the workers were so listed had an additional advantage. When the weekly production of all workers under a sub-foreman’s control was calculated, his performance could be articulated in the same way as that of his subordinates. Again, a somewhat heavier line was drawn beneath the name of the sub-foreman in question. Although he was not directly responsible for the number of goods produced, the comparison of the line of one sub-foreman with that of another, once again, gave the foreman an indication of their respective ability to solve the problems encountered by their workers. The heaviest line drawn on a Man Record Chart represented an average of the work performed by all groups of workers under the guidance of the different sub-foremen. This line was placed just below the name of the foreman responsible for the whole shop (figure 3).

Figure 3. A completed two-week Man Record Chart showing two sub-foreman–worker groups under the supervision of one foreman. The thicker lines show the aggregated weekly productivity of each worker, sub-foremen, and foreman (Clark 1942, 34).
The Man Record Chart was a technique of drawing lines and letters on sheets of paper that could provide a lot of information about individual and group productivity, but what was the nature of the facts it was to display? The first thing that Gantt charts made visible was the plethora of small problems that might otherwise escape notice. Each letter and unfinished line referred to a specific problem in the daily operation of the factory. From these basic facts it was then possible to reach a second, higher level of insight. When properly processed, the daily Man Record Charts enabled the interpreter to pinpoint structural weaknesses and enduring complexities in the organization. A foreman who studied a sequence of charts might, for instance, discover that particular symbols predominated. The abundance of Gs over a certain period of time could be indicative of insufficient instruction of new workers or of a high rate of labor turnover. A malfunctioning tool department could be exposed by too many Ts on the chart. Similarly, the lines could indicate possible problems in the production process. On an aggregated level, the efficiency of individuals becomes the efficiency of departments, and the efficiency of departments becomes that of the whole company. By comparing the Layout Chart that showed the load of work scheduled with the aggregated Man Record Charts, any discrepancy between the initial plan and the actual performance would come to the surface. This comparison enabled management to act wisely because its decisions could now be based “not only on carefully proven facts but also on a full appreciation of the importance of the momentum of those facts” (Clark 1942, 1). When the processing of the daily charts was complete, executives could begin to discern trends toward higher or lower production in their organization and could estimate more accurately when a certain job would be finished and a new one could be scheduled.

Lastly, from the information contained in the Man Record Charts, one could extract a new categorization of industrial workers. In a very literal sense, these charts were crucial in the formation of two distinct categories. As the workers were graphically represented by the thin lines below their names, Clark divided the workers into “short-line men” and “long-line men” (1942, 33–42). Obviously, the class of short-line group contained all workers who could not complete the task assigned to them in the time specified, while members of the long-line group managed to do so. However, this bifurcation also had a more substantial implication. The long-line workers generally posed no problem for management. They were satisfied with the official recognition of their talents and often welcomed the charts. The workers with short lines, however, behaved in a rather different fashion. They tended to be conscious of their inferiority and more
prone to distract other workers and to breach the discipline that should reign on the shop floor. With careful study of the charts, the foreman would discover that “this type is usually the backbone of strikes and discord in his department” (Clark 1942, 36). In order to prevent future labor troubles, he had to act upon the resentment and discontent that characterized these workers. He could look for a new job that better suited a specific short-line worker, or he could patiently instruct the worker, persevering until the feelings of discontent faded and made way for some sort of ambition. With the help of these new categories it was easier to distinguish one type of worker from the other and therefore determine the right kind of managerial intervention.

3.5 How to do things with charts

With the relationship between categorizing and handling of the labor force, we have moved from the chart as a tool for representing different facets of the organization to the chart as a technique for transforming industrial practice. The facts displayed on the chart did not only represent the organization, they were “so presented as to indicate the action which should be taken” (Clark 1942, 23). In a variety of ways, the charts reflected organizational facts back to all employees and distributed responsibility along the way. For although individual workers were the ultimate substrate of knowledge extraction as well as the final object of managerial intervention, the circulation of Gantt charts throughout the organization was expected to transform everyone involved. The individual worker, the foreman and the superintendent had to take notice of the results displayed on the charts in order to determine the best course of action.

As described above, the detailed information on the Man Record Chart enabled foremen to determine and compare the productivity of individual workers. It was now possible to assess the development of a single individual over time. One could trace, for instance, whether a green worker had improved her manual dexterity or whether she needed additional instruction from the foreman in order to reach the proper level of efficiency. Moreover, by placing individuals one below the other, it was now easy to see who was causing delays and who was not. When all the lines of the chart had been drawn, the foreman could locate what went wrong in a week or month by simply moving from the thickest line—summarizing the overall accomplishment of his department—to the thinner lines.
of his sub-foremen and further down to the thinnest lines of the workers under each sub-foreman’s command. By analyzing the lines and symbols, the foreman was induced to act in a particular manner.

Furthermore, the charting of synchronic and diachronic differences in productivity between employees was expected to have beneficial effects even without managerial intervention. The charts enlightened not only the foreman as to the productive and unproductive elements in the shop, for he also showed them to his subordinates “with the idea of developing their ambition and their interest” (Clark 1942, 33). The Man Record Chart, as Gantt designed it, directly communicated the performance of the workers back to them. When a worker saw a black box or a finished line on his row, he knew that he had earned his daily bonus, but a red box or an unfinished line informed him that he had not. According to Clark, the worker “appreciates the opportunity to watch his own progress from day to day” and he will use the knowledge of his past performance and that of his colleagues in trying to lengthen his ‘line’ or change his ‘color’ (1942, 33). Frequently, those unable to earn a bonus on a regular basis would ask for an instructor who could show them why they failed and help them to optimize their movements. Thus, the workers were now inclined to assist their foreman in the discovery and elimination of the obstacles that hampered the production process. The results of securing their cooperation were beneficial: “with a bonus as an incentive, and a proper instructor, a very fair proportion of the unskilled finally succeed in performing a task that was at first entirely beyond them” (Gantt 1919, 151). When presented to the worker in the right fashion, the Gantt chart could stimulate the worker’s ambition to improve. The chart was thus more than a management tool—it was equally a device for workers’ self-governance.

A third advantage of the Man Record Charts was also a result of their display to the workers. When workers had a clear idea of their own performance, managerial interventions would be considered more legitimate. A number of young women, for instance, preferred the use of these charts to determine their bonuses because they “were convinced of the fairness of distribution of the profits within their departments” (Clark 1942, 42). If one of them still had doubts about her (lack of) additional reward, then the various charts could be consulted to check her performance over the past days or weeks. The legitimacy of management decisions could also be increased when it came to career opportunities within the factory. The use of charts as a basis for promotion ensured that the decision was based on facts and not on impressions. This in turn would bring about the elimination of favoritism and special privilege and convince the workers of the
soundness of managerial judgment: “The workman sees the man whose line is longest, whose production is greatest, appointed to the position of sub-foreman when there is a vacancy. He sees the sub-foreman whose group line is longest become a foreman” (Clark 1942, 42). The charts thus gave the individual worker a good idea of the legitimate benefits that came with being a long-line worker. If the prospect of a bonus or a promotion was not a strong enough incentive, the fear of being fired certainly was. Short-line workers knew that, if factory work decreased, longer-line workers would be the more sought after. The positive inducement of a bonus was thus complemented with a negative inducement that acted “as a powerful stimulus to the unskilled, and all who have any ambition try to get into the bonus class” (Gantt 1919, 165).

These three effects of the Man Record Chart—assisting foremen, promoting self-management and legitimizing managerial decisions—were associated with the change of behavior on the part of the industrial workers. Yet the distribution of charts on the shop floor was only the first part of a more comprehensive transformation of industrial organizations. As I have shown, the soldiering worker was an important figure in discussions about systematic or scientific management; however, so too was the figure of the autonomous foreman who wielded his power over a subset of workers in an arbitrary way and resisted attempts to be governed by a higher authority. At the end of the nineteenth century, the shop floor was considered “the foreman’s empire” (Nelson 1995, 35–43). It was therefore difficult to bring the foreman in line with managerial purposes, for “many a man in authority wants a system that will force everybody else to do his duty, but will allow him to do as he pleases” (Gantt 1919, 163). The duplication of the Man Record Charts was the first step in the direction of tighter management control. With copies of all the relevant charts sent to the higher echelons of management, the superintendent could get a good impression of the productivity of his employees. Just as the charts helped the foreman to distinguish short-line from long-line workers, so with “the estimates of all the departments […] the superintendent is also enabled to compare the ability of his various foremen to get work done” (Clark 1942, 43). The foreman knew and governed his workers via the daily Man Record Charts but, at the same time, was also held accountable for their aggregate performance. Or, to put it differently, “the foreman or superintendent who is lax in his duty finds his shortcomings constantly brought before him by the man whose duty it is to investigate all cases of lost bonus” (Gantt 1919, 170). What was a tool for the foreman to assist and direct his subordinates thus became the instrument with which his own performance was measured and evaluated. Just like the short-line workers, the
foremen who were not responsive to monetary incentives or capable of removing the obstacles that hampered efficient production were confronted with the threat of dismissal. In management's ambition to “build up an organization composed of men who have proved their ability to produce”, there was no place for a foreman with too short a line (Clark 1942, 43).

Though the main purpose of the Man Record Chart was to induce workers and foremen to solve existing problems and increase their output, the visualization of industrial performance affected even the higher management echelons. A very attentive executive could discover that many of the problems for which workers were often blamed were actually the result of inaction higher up the organizational ladder. Because the charts already hint at the action that must be undertaken, “the man highest in authority finds that he also must conform to laws, if he wishes the proper co-operation of those under him” (Gantt 1919, 171). According to Gantt, the executive who thinks that “the sovereign care for all troubles is to go into the shop and raise a row, has no place under our methods” (1919, 162). Industrial leaders would contribute to the harmony and productivity of their firm only if they took the problems revealed on the charts seriously and actively tried to solve them. Clark went even further than his mentor and proposed to use the Progress Chart to estimate the contribution to production of those men who were highest in authority (1942, 102). This chart displayed the difference between the work scheduled and the work performed and was thus a proxy for the ability of the company’s executives to keep a tight schedule. In this way, even executive performance could be visualized.

All in all, the spread of Gantt charts throughout the entire organization transformed the atmosphere and interactions in the workplace:

The fact that under this system, everybody, high and low, is forced by his co-workers to do his duty (for some one else always suffers when he fails) acts a strong moral tonic to the community, and many whose ideas of truth and honesty are vague finds habits of truth and honesty forced upon them (Gantt 1919, 170–171).

The careless worker and the lax foreman fell into disfavor and made way for those who performed well. The increased sense of community possibly played a part in the creation of new collectives, such as the group of women who formed a society in which only those who earned their bonus were allowed.
The engineering of incentives

The engineers were the first self-declared experts on incentivizing industrial workers and foremen at the end of the nineteenth century. In the preceding sections, we have seen how they developed different wage incentive systems to increase the productivity of industrial workers and eliminate the sources of workers' mistrust of management. These systems became popular among the engineers as the missing link between the increased possibilities of machines and the undisclosed potential of the operators who had to work with them\(^\text{16}\). In this section, I will recapitulate the engineering of incentives in Foucauldian terms to make possible a fine-grained comparison between the three distinct governmentalities. It is important to note that, despite their differences, the American engineers I surveyed all rationalized the incentive, in particular, as an element of industrial government. They took their cue from the perceived malfunctioning practice of paying by the piece but added a distinct layer of reflection to it. Thereby, they turned the issue of how best to govern the labor force with the help of incentives from an ad hoc endeavor into a more systematic endeavor. The two distinct but interrelated elements that Foucault discerned in successive bodies of governmental thought are equally present in the engineers' rationalization of government. First, they delimited the worker as a particular human figure with particular characteristics and thus contributed to the formation of the subject as an object of knowledge. Second, they specified how a foreman or superintendent should behave and what instruments they had at their disposal. The end point of these reflections was a set of techniques of power that could be used by those in charge.

As an authority of delimitation in matters of incentives, the engineers began by giving the incentivizable subject a particular surface of emergence. They localized the subject that was to be incentivized at the place where they themselves were found most often: the industrial shop floor. Only the employees at the lowest level in the organizational hierarchy—that is, workers and foremen—were the ones truly in need of incentives. Even though the higher echelons of management were addressed by Gantt and Clark, no engineer tried to develop a wage incentive scheme for executives and senior managers. At the shop floor level, incentives were meant to address the interests of laborers and foremen in increasing their effort by way of output-related pay. The fact that the engineers all started from the same disciplinary background gave them something of a shared approach in the further delimitation of the incentivizable subject. That is, they had a similar grid of specification with which they determined the characteristics...
of the worker and foreman and the kinds of incentives that would suit them best. The engineers were primarily experts on the enhancement of machine efficiency, not on that of human performance. Thus, the main feature of the engineering approach to management problems was that the human factor was analyzed in terms similar to those used for industrial machines. What was common to the engineers surveyed above was “the idea that human activity could be measured, analyzed, and controlled by techniques analogous to those that had proved successful when applied to physical objects” (Aitken 1985, 16). This mechanical outlook on industrial problems permeated the delimitation of the incentivizable subject in three ways.

First, the engineers expected a stable and uniform relationship between cause and effect because the machines they worked with all operated in a mechanical way. Their study of mechanical processes thus led to well-directed, technical interventions with predictable outcomes. Management was equally a technical art for which the engineers could rely on their general expertise in solving machine problems. In the early analyses of the human factor in production, members of American Society of Mechanical Engineers immediately equated management with the technical problem of designing an adequate method of remuneration. Industrial productivity and harmony were major objectives indeed; but they could be achieved by way of a minor intervention. The wage incentive schemes should be constructed so that the expected behavior of the worker (increased effort) would not interfere with the expected behavior of management (wage cuts). The engineers believed that all human beings would respond to incentives in predictable ways because they had a materialistic outlook on life. Frederick Taylor began his Principles with the observation that the workman wanted a high wage and the employer sought only low labor costs (1998, 1). He thought that the worker “like every other human being, was motivated by rational self-interest” where self-interest was equivalent to “the monetary reward he received for his work” (Aitken 1985, 38). Gantt’s discussion of labor unions showed a similar preoccupation with the material side of human behavior. If management wished to prevent a worker from joining the union, it “must make it his interest not to do so. In other words, we must provide him with means of advancing his interest that is superior to what the union offers” (1919, 59).

Second, the engineers were used to working with machines that were made up of different elementary parts; it was always possible to deconstruct machines and study each of those elements separately (Gantt 1919, 38–41). This principle of compositionality equally permeated the analysis of human behavior. According
to Towne, a firm's total amount of profit was the effect of different factors that could be neatly separated from one another. He proposed to isolate the workers' contribution to production such that they could share in the gain they had actually brought about. Halsey's premium plan and the charts advocated by Gantt and Clark similarly evidenced a belief in compositionality. This time, the overall contribution of the laborers to productivity was separated into the contributions of individual workers and foremen. In addition, the mechanical engineers discovered the composite character of human action itself. Taylor's management system exposed him as the most firm believer in the compositionality of human action. In his view, a complex task consisted of a few basic movements, and one could therefore dismantle and reassemble the movements that were necessary for that task. Of course, one should take into account the fact that humans will become tired after performing these movements for a while. But what was fatigue if not the human equivalent of overburdening the machines? In both cases, you impaired long-term productivity by neglecting its existence.

Third, the engineers believed in the beneficial effects of standardization and measurement. They were convinced that the establishment of performance standards for machines was good for the enhancement of efficiency because it enabled them to keep track of the increased ability of machines to perform. Therefore, when they began to address management problems, they also set themselves the task of measuring human performance and developing standards for it. Halsey thought that the record of previous achievements should be consulted in order to establish a standard time for a given amount of work. The workers would subsequently try to work faster than the standard if they were rewarded for saving time on production. In contrast, Taylor thought that only scientific inquiry could lead to precise measurement and adequate standards. Both time and motion studies and wage experiments were therefore necessary to determine how hard people could work and how high the reward would have to be. For Gantt, finally, the measurement and standardization of daily performance made it possible to compare the output of different workers and different foremen. Thereby, managers could capture the development of human productivity over time and discern persistent problems in the production process.

However, the delimitation of the incentivizable subject as a materialistic worker or foreman whose behavior could be decomposed, measured, predicted and standardized is only a very rudimentary construct. The consulting engineers needed to determine, in a more detailed and fine-grained manner, the characteristics of the industrial employee that made him susceptible to incentivization. The
subjectivity of the worker did come to the surface in the wage incentive formulas but only in a very limited sense. Was the worker patient and therefore capable of waiting for his yearly pay envelope as Towne expected? Or was he so occupied with the short term that only Halsey's scheme of immediate gratification provided him with a proper incentive? In due time, the nature of the incentivizable subject became more circumscribed. Taylor's experiments with his subordinates at Midvale were meant to elucidate the precise amount of money that was necessary to secure cooperation. Together, the inquiry into the maximum exertion that could be demanded and the experimentally determined wage incentive would secure the compliance of the worker with the goals of management. In Gantt's method of organizational fact making, finally, the production of knowledge about the employees' performance was plugged directly into the organization. Via the charting of the performance of the workers and foremen, management could easily distinguish them from one another. The length of the productivity line on Clark's Man Record Chart showed the relative merits of each and all at a glance. Moreover, the letters used to indicate why a standard wasn't met enabled executives to easily locate problems and determine who or what was responsible for slowing down industrial processes. In addition, the public display of the charts ensured that knowledge about performance was also communicated back to the employees.

For the engineers, a basic materialism made the subject governable; thus, this view permeated the first rationalization of the incentive as a technique of power. The early management techniques show that the engineers mainly depended on monetary inducements to govern the labor force. The financial carrot that came with the introduction of either Towne's method of gain-sharing, Halsey's premium plan or Taylor's differential piece rates was expected to make employees work harder than before. It should lead to a combination of higher levels of productivity and lower levels of industrial conflict with only a limited increase in labor costs.

In Taylor's work, the wage incentive was already becoming more integrated into a management system that proposed to bring the behavior of the machine operators in line with the precepts of science. His position as foreman and chief engineer at Midvale enabled him to experiment with several management techniques. The accumulated results of his time and motion studies made possible a detailed description of the components of a specific task and the time needed to complete each of these components. In doing so, Taylor's scientific study of bodily movements simultaneously created a norm by which to judge the performance of individual workmen. In this way the task was introduced as a standard for
normal effort, which culminated in a normative divide between the failure and the success of getting the job done in time. In Taylor’s scientific management there was ample room for monetary incentives, but they were now bound up with detailed instruction cards that informed the worker of the specific movements and time needed for the task at hand.

The positions of Gantt and Clark in industry were similar to that held by Taylor. As consulting engineers they could implement their methods of charting the performance of laborers and foremen and receive direct feedback on the effects thereby produced. In their work, the incentive was equally integrated into a comprehensive program for representing and transforming industrial organizations. The Man Record Chart was a material technique to govern workers and foremen. Management was enabled to act in a fully informed way by the continuous flow of information that the charts generated—especially with regard to the difficult short-line workers. Moreover, the constant feedback given to employees about their own performance assisted them in their own self-governance. With the financial incentive as a positive inducement and the threat of future dismissal as a negative inducement, the charts stimulated workers to lengthen their own lines. Thereby, Gantt introduced a new element in the conceptions of industrial management: the government of workers and foremen could not do without surveillance and instruction, but it equally required the active support of the governed. However, workers would give that support only when managerial decisions were considered legitimate—that is where the justificatory side of the Man Record Chart comes in. As a power that was visually present, the charts delegated the authority to govern individuals, moving it from the sphere of human decision making to the non-human sphere of charted evidence. They informed their potential recipients that the distribution of bonuses was the indisputable consequence of lines drawn on a sheet of paper. As an additional consequence, the charts were to “secure fair play for both workman and owner” (Clark 1942, viii). Every managerial step—from providing assistance to distributing bonuses and promoting personnel—was now based on publicly available facts. The delegation of authority was thus intimately bound up with the justification of authority. When the charts were fully accepted by all those involved in the industrial process, they would become “the moving force of action” (Clark 1942, 3). The production of knowledge about performance would direct the action of managers, which, if effective, would result in longer lines on subsequent charts. Therefore, the circulation of these charts throughout the factory coupled a constant and detailed surveillance of each individual’s performance with more targeted and legitimate managerial interventions.