Chapter 2
Karl Marx – From Hand Tool to Machine Tool

Abstract In this chapter is presented the analysis that Marx leads about the transition from the mere tool (Handwerk) to the machninery (Maschinerie). According to Marx the consequences of this transfer of the manual implement from man to machine are: (a) the machine becomes the active, super powerful, but completely depersonalized subject in the production process; (b) the human body has to learn new actions that are dominated by automatic repetition; (c) the introduction of particular type of relationship between humans and machines: in this new "technological" master - slave relationship it is no longer a case of the instrument serving the man, but of the man serving the machine; (d) the new aspect of machinery: the enduring symbiont.

Keywords Marx • Toll • Machinery • Subject • Object • Depersonalization • Repetition • Master-slave relationship

According to Marx, the introduction of machines in industry was due not to the fact that using mechanical means to do some of the work could reduce the burden of fatigue for human beings, but to the discovery that a machine can be a formidable means for producing a surplus of goods. It shortens the part of the working day that the worker uses for himself, consequently prolonging the part of the working day that he makes available free of charge to the capitalist.

But this merely economic usage of the machine is not justifiable per se. Marx sees it as being founded on the particular nature of the "machine as a means", on what we might call its "inner structure". Unlike the passage that occurred with the advent of manufacturing, which was made possible by using the human workforce in a new way, the revolution that occurred in the industrial world with the birth of mass production was based exclusively on the new form acquired by the *means* that, from mere *tool* (*Handwerk*), had become *machinery* (*Maschinerie*).

Marx's analysis of the historical significance of this transition is ambivalent. On the one hand, he says it is impossible to draw "hard and fast lines of demarcation"[1];

[1] K. MARX, *Das Kapital Bd I*, in *Karl Marx-Friedrich Engels Werke*, Band 23, Vierter Abschnitt, Dietz Verlag, Berlin 1968, p. 391 (Eng. trans., by B. Fowkes. *Capital. A Critique of Political Economy*, I, ed. By E. Mandel. Penguin Books, London p. 392). There has been a renewed interest in the figure of Marx of late, also in relation to the topics discussed here. Among others, it is worth

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on the other, he pauses (not without some degree of admiration) to describe the revolutionary details of that "productive organism that is purely objective"[2] represented by the system of machines that the worker finds before him - not as a tool for him to use, but as a complex automaton that he must serve. This ambivalence in Marx's analysis cannot be seen as a shortcoming: it stems from the author's necessarily oscillating gaze when he examines the particular "historical context" of technological innovation. The new machine is the outcome of old machines being reassembled and incorporated as component parts of a new structure. Sometimes these single components are enlarged or miniaturized, but their shapes and functions are not new, they had already been configured in previous devices. In a given technological field, the latest machine to be built can never really be described as "revolutionary" if, by this term, we mean something that is "in discontinuity" or "incommensurable" vis-à-vis something that existed in the past. This does not alter the fact that such a machine can prompt enormous changes, the extent of which might even be amply underestimated were they to be described as a "revolution". In the description that he provides in *Capital*, Marx conveys his awareness of this duplicity of machinery. In what sense, he wonders, are the new machines used in mass production distinguishable from the craftsmen's traditional implements? Looking at the inner structure of each mechanical assembly suggests a general layout consisting of three parts: drive, transmission and machine tool, or working machine. The drive element induces the movement of the assembly as a whole. It can be powered by a human body or an animal, or by natural sources of "energy" such as water and wind. In its extreme stage of development, this propulsive power is supplied by other machines that convert the power of steam or electromagnetism to guarantee a virtually constant supply of the energy previously provided by external forces. The transmission element comprises a set of components such as wheels, belts, pulleys and shafts, that transfer and distribute the power to move the machine tool, make it change direction, or vary its speed. The third element is the working machine proper, the *raison d'être* for the whole mechanical assembly: it holds and processes the workpiece thus completing the production process. According to Marx, the huge changes that occurred in industrial production methods towards the end of the eighteenth century were triggered by improvements made to this third and last part of a machine. He described the structure of the working machine very precisely:

> On a closer examination of the working machine proper, we find in it, as a general rule, though often, no doubt, under very altered forms, the apparatus and tools used by the handicraftsman or manufacturing workman; with this difference, that instead of being human implements, they are the implements of a mechanism, or mechanical implements. Either the entire machine is only a more or less altered mechanical edition of the old handicraft tool, as, for instance, the power-loom, or the working parts fitted in the frame of the machine are

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mentioning E. MICHAEL, *Kapital und Technik*, J.H. Röll, Dettelbach 2000; J. VIOULAC, *L' époque de la technique; Marx, Heidegger et l'accomplissement de la métaphysique*, Presses Univ. de France, Paris 2009; A. BRADLEY, *Originary Technicity. The Theory of Technology from Marx to Derrida,* Palgrave Macmillan, Basingstoke 2011.

[2] Ivi, p. 405 (p. 407).

> old acquaintances, as spindles are in a mule, needles in a stocking-loom, saws in a sawing-machine, and knives in a chopping machine, … *The machine proper is therefore a mechanism that, after being set in motion, performs with its tools the same operations that were formerly done by the workman with similar tools.*[3]

The working part of the machine therefore does not use different processing tools from those used by human hands. The same tools (albeit with some changes in their dimensions) are attached to the machine. So, if we consider the machine as a whole, including its drive and transmission elements, we could say that there is nothing innovative about it. Its inner structure simply reiterates that typically human technicism represented by the link between a man and his implement. It is only by virtue of a *repetition* - that must be as conservative as possible in order to function - that the machine can replace the craftsmen. The machine dispossesses the worker of his tools, and of the confidence with which he used them, taking his place in the final stage of the production process, the one in which the object is given the required *form*.

The essence of the process of mechanization in industry lies, according to Marx, in this handover, which was immediately followed by the related process of industrialization, implemented by means of a massive multiplication of the number of tools capable of working simultaneously on the holder of the same machine. A human being can only work effectively with one tool at a time. A machine can operate simultaneously with a far greater number of tools. Even in Marx's time, people were amazed when they saw that even the less innovative spinning machines could work with 12 or 18 spindles at once, whereas even the most capable human worker could only cope with one.

The machine brought two elements together in the same assembly: an exact repetition of the *form* of human implements (which corresponded to the shape of the product in reverse); and the chance to go beyond the capacity for work of the organic body of the human worker. The type of production previously assured by a human hand holding a tool remained the same. The machine performed the same spinning and stitching actions. But the machine allowed for the number of tools at work per unit of time to be multiplied, and the rate at which the single operations were performed could be increased. The machine could work like a sort of giant human worker equipped with a huge number of hands, all capable of working at a much faster rate than a human worker, however dexterous he might be.

The essence of the machine lay in the merely "instrumental" conception of the technical means being abandoned for good. As Marx put it:

> The machine, which is the starting-point of the industrial revolution, supersedes the workman, who handles a single tool, by a mechanism operating with a number of similar tools, and set in motion by a single motive power, whatever the form of that power may be. *Here we have the machine, but only as an elementary factor of production by machinery.*[4]

[3] Ivi, p. 394, pp. 494–495.

[4] Ivi, p. 396, p. 497.

The passage from the hand using the tool to the latter being attached to a mechanical holder initially left the worker serving just two purposes: to supply the energy needed to drive the machine's movements and to visually monitor its performance. Marx makes the point that, in actual fact, the ever larger size of the working machines and the increasing number of tools operating simultaneously very soon made it necessary to develop larger drive means, that in turn demanded quantities of energy that neither humans nor animals could deliver. All animate beings were thus definitively expelled from the operating circuit of the machinery, and human beings were ultimately only needed in a "supervisory" role, as mere outside observers of a chain of operations that the machine could now perform entirely unassisted:

> As soon as tools had been converted from being manual implements of man into implements of a mechanical apparatus, of a machine, the motive mechanism also acquired an independent form, entirely emancipated from the restraints of human strength. Thereupon the individual machine, that we have hitherto been considering, sinks into a mere factor in production by machinery. One motive mechanism was now able to drive many machines at once.[5]

According to Marx, it was the transfer of the tool from the human hand to the machine that prompted an increase in the power needed to make the whole apparatus move. It was consequently the quality of the work and the intensity of the repetitions per unit of time that led to the steam engine being connected to a mechanical loom, not the other way around. Watt's discovery alone would have failed to transform the industrial process, had it not been possible to transform the process into a mechanism. The machine is not the worker, but it can replace the worker because it operates *as if* it were the worker. Had this transfer of the manual implement from man to machine proved impossible (as is still the case for some human functions), we would not have witnessed the expansion of the Promethean protocol that lay behind the Industrial Revolution. Already in Marx's writings, this revolution came to appear as the expression of a wonderful process of humanization of the world with the machine installed at its active center. It replaced the worker, but by no means supplanted human technical expertise. Quite the opposite, it focused on copying man's structural features and movements ever more effectively, thereby achieving ever higher levels of performativity.

Like humans, machines can cooperate in the workplace. According to Marx, they can join forces in various ways: as agglomerates of homogeneous machines that are all activated simultaneously, or as chains of different or partial machines that contribute to the end product, each completing a part of the total workload.

In the former case, the whole product is completed by the same machine, by means of different tools all incorporated in the same body. The manufacturing of envelopes for letters once involved the workers completing a precise sequence of operations: one folded the paper with a ruler, another added the glue, a third opened the flap where the watermarking was applied, a fourth added an embossed stamp, and so on. Already the earliest machines for making envelopes could simultaneously complete all these steps, producing more than 3000 envelopes in an hour. A

[5] Ivi, p. 398, p. 499.

production process that was initially completed in a series of successive steps, passing the product from one hand to the next, could now be completed on the same machine equipped with different tools. Multiplying the number of these homogeneous devices being powered by the same engine gave rise to a simple form of cooperation.

The situation is different in other industrial processes. In the woolen industry, for instance (a typical example of a process divided into parts and distributed amongst different workers), the various operations – beating, carding, combing, spinning – are completed by linking together different, dedicated machines, each of which can be seen as an "organ" capable of performing a particular "function". This is a complex form of cooperation that actually represents the translation in mechanistic terms of a system for distributing the workload that already existed in the manufacturing world. The flow chart according to which the product derives from a succession of partial processes distributed amongst different manipulators, each working according to their subjective characteristics (individual capacity, physical form, mutual distance) is reiterated in an objective form by machinery, with the advantage of a greater continuity in the completion of the process as a whole.

Here again, the system of machines imposes an intensification of parameters such as the rate at which each partial process is completed, and the speed with which each machine forwards the material being processed to the next machine. The sequence of actions completed by each machine, and the succession of "handovers" from one machine to the next are still based on the human flowchart previously adopted in the factories, and this human organization provided the basic foundations for the technical cooperation entrusted to the machinery.

This cooperative work required of the machines also relies on the availability of a greater power supply:

> Just as the individual machine retains a dwarfish character, so long as it is worked by the power of man alone, and just as no system of machinery could be properly developed before the steam-engine took the place of the earlier motive powers, animals, wind, and even water; so, too, modern industry was crippled in its complete development, so long as its characteristic instrument of production, the machine, owed its existence to personal strength and personal skill, and depended on the muscular development, the keenness of sight, and the cunning of hand, with which the detail workmen in manufactures, and the manual laborers in handicrafts, wielded their dwarfish implements.[6]

Mass production was made possible by overcoming the boundaries imposed on the work by the technical capacity of the human machine. Human tools based on the link between eye and hand not only have intrinsic limits in terms of their precision, but are also moved by a set of muscles of very limited power that soon tire. They also depend structurally on subjective conditions that make it impossible to predict the mean efficiency of the system.

The machine takes on the mechanical part of the human's job and improves the performance of the single apparatuses, functioning like a more powerful, desubjectivized version of the human worker. In the way machines cooperate, we can

[6] Ivi, p. 403, p. 504.

see the same law of substitution at work. The republic of the machines does not cancel the form of human work, it repeats its instrumental quality at every single step. But it also speeds up the connections between the successive steps in the production process, depersonalizing the overall movement. What cooperating machines achieve is simply the mechanical integration of collective, multiple and differentiated needs with the different capabilities of each individual component part of the machine assembly, where "individual" is no longer an element that may be dysfunctional for "subjective" reasons; it is always a perfectly efficient component that does exactly the job required of it, for which purpose it has been fashioned.

Given this linking together of different devices, the worker interacts no longer with the single machine, but with the whole factory system. The machinery becomes a sort of enormous automaton consisting of innumerable mechanical parts, all reliant on a single power supply and connected to other non-mechanical parts, i.e. the limbs and eyes of the human operators. Marx describes this new situation in various ways:

> All work at a machine, requires the workman should be taught from childhood, in order that he may learn to adapt his own movements to the uniform and unceasing motion of an automaton. When the machinery, as a whole, forms a system of manifold machines, working simultaneously and in concert, the co-operation based upon it, requires the distribution of various groups of workmen among the different kinds of machines. But the employment of machinery does away with the necessity of crystallizing this distribution after the manner of Manufacture, by the constant annexation of a particular man to a particular function. Since the motion of the whole system does not proceed from the workman, but from the machinery, a change of persons can take place at any time without an interruption of the work.[7]

According to Marx, the consequences of this fully-automated organization of the workload in the factory are as follows.

The machine becomes the active, but completely depersonalized *subject* in the production process.

Humans become not the object of this process, but subordinates of the machine, serving as its *instrument*. While in traditional manufacturing the tool was adapted to the capabilities of the human operator's hand, now it is the body of the worker that has to be adapted so that it can interact efficiently with the machine. The human hand has to learn new gestures that are dominated by automatic repetition.

The standardization of the worker's movements (by virtue of which the steps in the industrial process can be simplified and reduced to a few essential actions in each phase of the process) assures an unlimited interchangeability of the human instrument involved. The worker can be connected equally well to any part of the device, he no longer needs to have any specialization. Taking a more general view, this puts an end to all the hierarchies and all the differences deriving from the personal skills of different workers in the old manufacturing world. Now, as far as the machine is concerned, they are *all the same*.

[7] Ivi, p. 443, p. 546.

This introduces and consolidates a particular type of relationship between humans and machines: in this new "technological" master-slave relationship *it is no longer a case of the instrument that serves the man, but of the man who serves the machine*. The novel characteristic of this interaction lies in that one of the elements in the relationship is no longer another human being, a master, but an entirely impersonal mechanism that Marx does not hesitate to qualify (rather romantically) as something that is "dead" as opposed to the living being incarnated by the worker.

As we know, Marx believed that this relationship depended not on the construction of machines as working means, but on the capitalist usage of them. He was convinced that, in the context of another social form of production, the relationship between man and machine could be reversed in favor of the former, and an ultimately humanized form of labor.

In actual fact, what Marx begins to foresee in some of its essential features is a new form of social life that develops under its own steam and irrespective of the economic model in which it first emerged. It stems not from any particular context, but from the structural form, functions and performativity of the leading characters involved. That the machine should be taken very seriously as a partner in a social relationship stems from the fact that its first appearance on the scene met with immediate, very strong negative reactions. Traditional workers saw the machines as formidable competitors and waged war against them right from the start. They initially imagined the destruction of this inanimate enemy as the only solution.

Such antagonism and the associated desire for revenge can only be explained by assuming that the workers implicitly acknowledged that the machines could really compete in the bid for work. This would not have happened if there were nothing human about machines, if they were wholly foreign to humans and their needs. But machines not only produce *for* humans, satisfying human demands, they are also the product of human expertise, they copy (repeatedly, and on a larger scale) certain human technical skills. It is in terms of these skills that machines can compete with humans, and they often win. The machine thus becomes one of the terms in a genuinely agonistic relationship, the possible outcome of which might be the destruction of one of the contenders, or the reciprocal improvement of both.

Marx grasps this situation very well, but he interprets it, once again, as the product of the essential confusion between tool and use. Machines rob the workers of their job because they become part of the capitalistic way of generating wealth. So Marx qualifies the struggle to destroy the new machines as "stupid", believing that the workers' attention should focus on the capitalist instead. If the machines crush the workers, if they override them and make the workers' skills so worthless that they may even lose their jobs, this is because the machines are being used by their owners to increase their profits. In another economic order, what Marx calls the mechanical means *in itself* would have very different effects:

> *The contradictions and antagonisms inseparable from the capitalist employment of machinery, do not exist, they say, since they do not arise out of machinery, as such, but out of its capitalist employment!* Since therefore machinery, considered alone, shortens the hours of labor, but, when in the service of capital, lengthens them; since in itself it lightens labor, but when employed by capital, heightens the intensity of labor; since in itself it is a victory of

> man over the forces of Nature, but in the hands of capital, makes man the slave of those forces; since in itself it increases the wealth of the producers, but in the hands of capital, makes them paupers […].[8]

So the machine has in itself an essence entirely independent of the conditions in which it is employed. If the machine could operate outside the capitalistic production rationale, in an entirely neutral manner, operating on its own logic, it would *reduce* the working hours, it would *reduce* the intensity of the repetitions, and it would *free* the worker from the dominion of natural forces. But how can we configure this alternative usage more precisely? What idea of technological working does it draw on?

In actual fact, what Marx means when he imagines a non-capitalistic use of machines coincides with his idea of "humanized work", i.e. technological practices undertaken within the limits of the force available to the average human being. The machine *should work* as much as a man *can work*, and that is to say for a limited amount of time, at a rate that prevents him from becoming overtired, and with the general goal of releasing him from the constraints imposed by his work. Clearly, an approach of this kind can only stem from a decision that has nothing to do with the nature of machines, but derives from the "economic" rules that humans agree to apply to their use of these devices. Just as there can be a dehumanizing capitalistic way of using the machines that has the effect of crushing the workers, there can also be a "human" usage of the same devices. The method chosen depends not on the machine in itself, but on the boundary conditions imposed by human relationships. Marx sees the machine in itself as neither good nor bad, but it can be set to different – good or bad - economic uses.

It goes without saying that Marx also sees the devices manufactured by man as a sort of externalized *alter ego*. They emerge from eminently human needs and capabilities. But our relationship with our machines unequivocally triggers opportunities for us to make significant changes to the conditions that enable us to inhabit our world. This circumstance may be interpreted differently depending on the degree of variability that we attribute to so-called human "nature". If we see this nature as having a permanent, unchangeable "measure", our relationship with our machines will inevitably carry an intrinsic risk of dehumanization. On the other hand, if we think that humanity has not been cast in an inextensible "mold", and that man is a variable entity that can be shaped and adapted to the circumstances, then the new stimuli deriving from our symbiosis with our devices could lead to an alienation that will certainly change us, but may not necessarily be dehumanizing.

It is also to Marx that we owe some of the most profound analyses on how people's working conditions changed as a result of the introduction of machinery and mass production:

> In so far as machinery dispenses with muscular power, it becomes a means of employing laborers of slight muscular strength, and those whose bodily development is incomplete, but whose limbs are all the more supple. The labor of women and children was, therefore, the first thing sought for by capitalists who used machinery […]

[8] Ivi, p. 464, p. 568.

> If machinery be the most powerful means for increasing the productiveness of labor — i.e., for shortening the working-time required in the production of a commodity, it becomes in the hands of capital the most powerful means, in those industries first invaded by it, for lengthening the working-day beyond all bounds set by human nature. […] Hence that remarkable phenomenon in the history of modern industry, that machinery sweeps away every moral and natural restriction on the length of the working-day. Hence, too, the economic paradox, that the most powerful instrument for shortening labor-time, becomes the most unfailing means for placing every moment of the laborer's time and that of his family, at the disposal of the capitalist for the purpose of expanding the value of his capital.
>
> The immoderate lengthening of the working-day, produced by machinery in the hands of capital, leads to a reaction on the part of society, the very sources of whose life are menaced; and, thence, to a normal working-day whose length is fixed by law. Thenceforth a phenomenon, that we have already met with, namely, the intensification of labor, develops into great importance. […] The shortening of the hours of labor creates, to begin with, the subjective conditions for the condensation of labor, by enabling the workman to exert more strength in a given time. So soon as that shortening becomes compulsory, machinery becomes in the hands of capital the objective means, systematically employed for squeezing out more labor in a given time. This is effected in two ways: by *increasing the speed of the machinery*, and by *giving the workman more machinery to tent.*[9]

The real relationship between man and machine involves specific actions, cognitive and motor patterns that are learned and then repeated with a variable frequency – and this is basically what happens for any type of human activity, not only for work.

Marx begins to see that the advent of the machine as a privileged partner leads to changes in some of the parameters governing the performance of human actions as part of the working process. The power mobilized by machines can be applied with a minimal effort by any human operator of average ability. This has the effect of making anybody a potential worker, not only adult males, but women and children too. Of course, we cannot fail to agree with Marx's condemnation of this situation, given the way in which this opportunity was exploited. But the end result is the concept that, in the world of machines, where human strength is no longer important, anyone can interact with these mechanical devices and use them to take action. Man interacts with the machine in a very natural way, and individual differences no longer significantly influence this interaction.

The time spent in action also changes dramatically. We can operate the machine without any limits on the working day. The machine becomes a sort of "lasting symbiont", a discrete, untiring company throughout a person's waking day. Our body needs even quite long periods of rest and sleep, but as soon as we are ready, we find the machine waiting for us and we take up from where we had left off. Slowly but surely, with the help of our machines, our living hours tend to be transformed into working hours.

The type of action required of the machine operator is no longer in any way comparable with that of a man handling his tools. The frequency with which the action on the production line can be repeated without the global quality of the process suffering leaves absolutely no space for the slow work of the craftsman. The

[9] Ivi, p. 414 e sgg., p. 517 sgg.

machine intensifies the human action, and this acceleration of the process has a feedback effect on the human operator, whose relationship with the machine induces him to develop mechanical movements that he also uses in his other actions and interactions with the world.

So far, all this has been seen as one of the ways in which human beings have been dehumanized. But nowadays we are not so sure that this is necessarily the case.

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