Technology: a tool in the hands of a few

A contemporary marxist approach

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Abstract

This essay presents a brief survey on some of the basic questions concerning the Philosophy of Technology, including the different historical perspectives regarding the part played by technology in human life and societies. From the historical debate between the more pragmatic and the more skeptical sides, the optimistic and pessimistic views, an answer is proposed, finding support in a sociological point of view in what can be interpreted as a contemporary marxist approach on these problems. This work was developed in the context of the course *An Introduction to the History of Science* given by Professor Luca Maria Possati, part of the Philosophy degree at the Faculty of Arts and Humanities of University of Porto, Portugal.

1   Introduction

Is technology just a tool? And, if it's not, what part does it play in our lives? How does it influence us and to what extent? Are we able to control it or are we under its control? These are some of the key questions that arise when we *think* about technology which seem to be getting more and more present in our lives as the years go by in the path lead by humanity. Indeed, machines are getting "smarter", the topic of the day is something called *machine learning* and the ones skilled in these self-learning and evolving algorithms (prequels to

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machines' souls, one might have the audacity to say) are the modern champions of humanity, like the sky navigators were in the XVI century's sea exploration or like the mechanical engineers were back in the industrial revolutions that took place at the end of the last millennium.

This work is organized in the following way. In Section 2 the main questions addressed in this essay are presented. In Section 3 the two classical schools of thought on Philosophy of Technology are briefly introduced and, in Section 4, some of the most important thinkers of each school are presented. The marxist analysis on technological evolution and the role it plays in human life is then discussed, in Section 5, as a connection between the two different paradigms of thought. Finally, in Section 6, some conclusions and considerations are drawn, later developments are briefly mentioned and a personal take on the questions raised is proposed.

2 Technology as a means to an end?

We start by returning to the first question produced in the beginning of this text: *is technology just a tool?* The question itself, of course, already says something about technology: that it *is*, in fact, a tool. There is no denial of this: humans craft new objects, develop new artifacts in order to make their lives better or easier in some sense. Even when the artifact reveals itself useless, there is always some idea of practicality behind its development. The question is not, therefore, if technology is a means to an end. The real question philosophers reflect upon is wether technology is *merely* a means to an end or if it is something more with direct influence on the lives of the people who develop it in the first place and use it on a daily basis.

Consider a hammer, for instance, a tool probably developed to address the problem of attaching different objects together, or breaking them down, and for protection. It is easy to see that even such a simple piece of ancient technology produced direct consequences on humanity. Certainly there were physical consequences on the workers using the hammer, in terms of physical posture, hand musculature and so on. Some of these changes induced in the workers' physique may be regarded as positive, some as negative, but it is evident that

this new technology did transform, even if just slightly, the bodies of the humans using it. Additionally, the use of a new piece of technology can require further adaptation and specific training towards an effective use of it. Without realizing it, we have arrived to a point of connection between two different types of skills: the physical and the technical.

Our example of the hammer might be too simplistic at this instance, but let's try to put ourselves in the place of the first humans that ever used a hammer and imagine how it must have been for them. As much as the hammer constitutes an example of a technology of straightforward application, one that even a primate would be able to use, the fact is that, however negligible the learning curve for its use might be, there is one and we can only speculate on how much adaptation and skill mastery it took for the first who wielded it more than three million years ago, deprived they were of any sort of experience to guide them. There is, indeed, a particular skill needed to master the use of the hammer which, in turn, contributed to the continuous perfection of this tool along the history of mankind.

Nevertheless, these are not the fundamental changes that were alluded above. There is a different set of changes induced by technology which are not physical or physically related such as skill development, but rather more profound, deeply connected to human thought, changes that operate on the universe of ideas that inhabit human minds and define, more than anything else, human activity and human relations. The hammer, as any piece of technology, being a tool, a means to an end, is meant to solve some problem in human experience. With its invention, either that problem ceases to exist completely or it will start to be perceived in a completely different manner. The problem of attaching objects together was transformed with the hammer and workers changed their thoughts on the subject. They stopped considering other alternatives, other techniques and freed up some "thinking space" for a whole new set of problems to be considered. There was a change, a real and effective change in the way people thought about several problems concerning, for instance, construction.

Now if we drop the hammer example and pursue other types of more sophisticated technology, more subliminar in their use, more incorporated with human activity, like automobiles, cellphones or the internet, then we can see

how easily these kind of changes assume rather relevant, profound and delicate consequences. We can refer to the so-called «embodied technology», that is, artifacts that are used as a part of one's own body; «present at end» technology, that is, artifacts used without any conscience of them, only acknowledging them when they malfunction or break. It is easy to see the growing influence of such artifacts in human mind and activity. As a starting point, there is a distinction between the so-called *ancient* technology, like the hammer, somehow more limited and controllable in its effects on humanity, and the *modern* technology, of which the many gadgets we are surrounded by are good examples of. In the next section, a brief introduction of the two classical perspectives on this matter will be presented.

3 Two schools of thought

Perhaps the crucial aspect when we think about technology lies within its polymorphous essence. How can one define technology, specifically modern technology, if not with a set of different concepts that join under this human enterprise. Indeed, technology can be seen as an *activity*, of course, a *human* activity, but also as *knowledge*, studied as an *object* or even as a *volition*, an independent will. The branch of Philosophy devoted to this matter is called the Philosophy of Technology and its many approaches can be grouped (Mitcham, [19]) into two major schools of thought: the engineering and the humanities discourses.

The name Philosophy of Technology, as the general discipline devoted to this topic, was firstly used by Ernst Kapp, a German thinker of the engineering line of thought, entitling is 1877 work *Elements of a Philosophy of Technology*, [13]. Historically the first type of Philosophy of Technology, the engineering school owes its name to the fact of having developed on the shoulders of Mechanical Philosophy, a line of thought whose aim was to explain all natural phenomena based on mechanical principles only, and of the Philosophy of Manufactures, a first attempt of thinking about the new productive factory industries as a whole different matter than ancient craft production.

These primordial lines of thought, which orbited around the industrial rev-

olutions, were initially took upon by engineers or even scientists, like Newton or Boyle for example, directly connected to the engineering process, that is, with the invention and creation of new machines. Engineering Philosophy of Technology can be defined, therefore, as an approach to understand technology and its implications in human life and the world from within technology itself, a somewhat more pragmatic analysis, centered on artifacts and its nature, its concepts, methods, cognitive structures and objective manifestations.

From a completely different, sometimes depicted as romantic, viewpoint, arises the Humanities Philosophy of Technology. The humanities school of thought brings to the table perspectives that go beyond technology, in a completely different approach than the engineering school. Indeed, instead of studying the consequences of technology in the world — like the engineering branch does —, it considers how technology fits into a wider, and perhaps metaphysical, conception of the world. Humanities Philosophy of Technology sits on the basic principle of primacy of humanities over technology and while Engineering Philosophy of Technology is the first of the two branches to have developed, humanities are undisputedly the birth bringers of technology in its first forms. The thought of some important members of both branches will be briefly surveyed in the following section. A detailed survey can be found, for instance, in the first chapters of [19].

4   Some historical perspectives

Even before philosophers of the engineering branch started thinking about technology, the Philosophy of Manufacturers, whose name is due to Scottish physician and chemical engineer Andrew Ure, was developed with the aim of devising the general principles that should guide productive industry with self-acting machines (see [5]). The main topics of interest were the differences between craft and factory production, chemical and mechanical processes, to work out a classification of machines, as well as coming up with a set of rules for invention and studying the socioeconomic consequences of automatic machinery. We can see that a substancial set of concerns were already addressed here in the beginning of the XIX century, right at the center of the industrial revolution.

One of the first members of the Engineering Philosophy of Technology was the german philosopher Ernst Kapp, briefly mentioned in the previous section. Kapp, who lived between 1808 and 1896, was also a geographer, deeply influenced by the work of Carl Ritter, one of the founders of modern geography. In the work of Kapp, [13], we see, therefore, a kind of environmental philosophy that seeks to explain the social and cultural manifestations in relation to the influence of the geography of the locations, like the influence of rivers on population development. Kapp comes up with the idea of *inner colonization*, that is, that technology presents itself as a way of human colonization of either space, through agriculture, mining, architecture or civil engineering, and time, through systems of communication, with the final objective of transforming nature, the whole world, into a truly human habitat. Another of Kapp's key concepts is one he "took" and elaborated from Aristotle: that tools and weapons, human artifacts in general, are just *organ projections*. In Kapp's view each artifact is just a tool developed, sometimes subconsciously, to enhance some human organ capability, like the hook enhances the bent finger, the sword, the sturdy position of the arm, or even the railroad and the telegraph can be interpreted as nothing more than the enhancements of the human circulatory and nervous systems, respectively.

Another influential thinker from the engineering branch was the German physicist Friedrich Dessauer who lived almost a century later than Kapp, between 1881 and 1963. Although Dessauer recognized the importance of technology through engineering in the reshaping of human life, he also was deeply concerned with the ethical problems around it. Together with Franz Xavier von Hornstein, he published a book in 1945, whose german title could be translated by as *The soul under the influence of technology*, [1]. Following Kant's *Critique of Pure Reason*, [12], he adds a fourth critique of technological making. Contrary to Kant, Dessauer sees this aspect of human activity as being able to establish a connection with the transcendental dimension where the true essence of things exist. This property of technology is not present in industrial manufacture, nor in the products themselves, but solely in the act of technical creation.

Peter Engelmeier, a Russian engineer, contemporary to Dessauer, very concerned with the ethical and political problems around technology, divided this act of creation into three constitutive parts: will, knowledge and skill. Other

thinkers had similar approaches: DuBois-Reymond considered invention as a psychological event and as a material artifact, while Max Eyth established the difference between creative germination of an idea, its development and its final use. In their own way, they all emphasize the role of creative inspiration in the act of invention, identifying the figure of the engineer with the one of the artist, in what can be interpreted as a clear connection with the humanities side (see [19] for detailed references on these authors).

Nevertheless, although Dessauer considers nature and human purpose as necessary conditions for human invention, he doesn't consider them to be sufficient, that is, there is a kind of invisible force that drives the whole process. He calls it the *inner working out*, a force capable of establishing a connection between the mind of the inventor and a fourth realm of preexistent solutions to technical problems, a link between the world of ideas and the real world where inventions work, a point of contact with the essence of things — there is much of Plato's theory of ideas in this conception. For Dessauer, the many dramatic consequences of modern technology on the planet and human life are evidence of this transcendent property of technology. Its power goes beyond the control and expectations of its creators and brings into play forces that seem supernatural, like for instance the atomic bomb. This singularity in Dessauer's thought drives him way from standard Engineering Philosophy of Technology and brings him closer to the humanities side.

Dessauers's religious conception of technology will be continued later on by the Spanish-Venezuelan philosopher Juan David García Bacca (1901-1992) who also considered the role of the inventor as central and supernatural, [6], — he compared it to God's own power of creation. Like God, human beings could create things that could stand for themselves and he gives the example of the computer, the perfect extension of human thought. This power is somehow independent, with the ability of enhancing its creators or degrade and destroy them. He defines technology as a per-objectifying and dis-alienating enterprise, that is, a planned, humanly designed activity involving the creation of technological objects that execute their functions beyond accidental use with the final aim of humanizing the natural universe.

Other thinkers from the engineering side worth mentioning were: Alfred

Espinas, [3], a follower of Kapp's organ projection theory who considered the difference between techniques and two types of technology, systematic organization of some technique and the ones involving the generalization of principles; Jacques Lafitte, [14], who coined the term *mechanology*, the discipline devoted to the systematic study of the evolution of machines from passive to active and reflexive; and Gilbert Simondon, [22], who examines machines dividing them among elements of machines, individual machines and systems of machines.

When we turn our compass to the humanities school of thought we immediately feel a shift to a more pessimistic or at least more cautious take on technology. Among the philosophers of the humanities branch, there are four fundamental representatives. Lewis Mumford, who lived between 1895 and 1976, is the first one. His line of thought starts by recognizing the limitations of machines in their aim to imitate human organs, [20]. That imitation is always imperfect and it creates a conflict between the organic and the non-organic that often results in grave accidents. He distinguishes between the mimetic technologies and the purely symbolic ones like information technologies.

The key idea in Mumford's philosophy is that it is not technology that defines humanity nor it is the ability to create: what defines humanity is its ability to think and interpret nature. Without technology Man would still be human, Mumford acknowledges, but without the power of thinking, there wouldn't be much of a difference between Man and the other animals. In his critique, Mumford distinguishes between the primordial forms of creation, the ones related with life and basic human needs, which he calls *polytechnics*, and those forms of authoritarian technics of creation intimately related with economic or military superiority and expansion aspirations, which he calls *monotechnics*. For Mumford, modern technology is just an example of monotechnics, which can also be found along history's pages in huge armies and organized work forces, which he refers to as *megamachines*. This is where Mumford introduces his most original idea known as the *myth of the machine*. Indeed, megamachines always come with the promise of high benefits for all, hiding the hard truth behind it that is: it comes with the cost of dehumanizing and depriving the people of their own freedoms. Therefore, it is necessary to impose limitations to modern technology's uncontrolled expansion and, in view of that, Mumford points at art and urban life as ways to do it.

A completely different perspective is given out by the Spanish philosopher José Ortega y Gasset (1883-1955) who conceives humanity as being defined by its creative side, since humans, unlike other animals, aren't born with a particular nature and have to "craft" their own existence in what can be regarded as a very classical philosophical take on human essence. He describes, in [21], the evolution of technics side by side with the evolution of science and analytical and abstract thought and he doesn't see any particular problem for humanity regarding modern technology. The only issue he foresees is a certain tendency for humanity to hand in the development of technology to mere technicians, that is, people devoid of imagination and creativity, which, in his opinion, are the crucial faculties that drive human evolution.

The third name in this shortlist of the humanities philosophers is the German philosopher Martin Heidegger (1889-1976). His thought, present in [9], shares a certain metaphysical and ontological perspective on technology that we can also find in Ortega, a certain inevitability, like an invisible hand that we cannot control. Like Ortega, the projection of humanity into the world through technology is not natural or organic: it is disruptive. However, Heidegger's view shares no fraction of the optimism present in Ortega's thought. In a similar form than Mumford's, Heidegger distinguishes between ancient and modern technology and focuses on this last one. He defines it as a *revealing* that prepares and challenges nature, extracting from it a kind of unnatural energy that can be stored and transmitted for later usage. Modern artifacts are, therefore, qualified as a *standing reserve* as they stand ready and available to be used in anyways considered necessary. Unlike ancient technology, modern technology doesn't adapt to the environment. On the contrary, they change it dramatically, as modern artifacts forms are hostages to their internal structure. Modern technology doesn't create: it unlocks a natural potential, harvests it, stores it and transmits it. One could eventually argue that some of these consequences emerge from mass production and the economic system, but Heidegger disagrees: it is the very nature of the objects produced which don't have inherent value — their value is given by human usage only. Additionally, Heidegger sees modern science enslaved by modern technology's logic, as an exercise of separating the world from its natural essence, in a process of objectification. For him, modern science is theoretical technology more than modern technology

being an applied science.

When Heidegger is asked to elaborate on the technological revealing, the original concept introduced by himself, he takes a step deeper into the transcendent. Indeed, Heidegger comes up with another concept, that he calls *Ge-stell*, a transcendental precondition for modern technology above any individual or collective human decision. Ge-stell is an attitude towards the world, an impersonal will that challenges the world and sets up the conditions for the implementation of the standing reserve. It is clear, therefore, that for Heidegger human will, being important, it is not the more relevant or, at least, not the only force that generates modern technology: it is also the nature of reality itself that opens up to its own exploitation. Ontologically speaking, Heidegger's proposition contains serious consequences regarding the *being*, the essence of things and, coincidentally, Heidegger's main philosophical topic of interest: according to this philosopher, the being of things can only be revealed by a supernatural force that he calls Ge-stell. In other words, we cannot truly understand technology in terms of itself, of its artifacts, of craft or its human creation, which constitutes a definite criticism on Engineering Philosophy of Technology thinkers, although one can easily see a link between Ge-stell and Dessauer's inner working out. Usually, Heidegger is seen as a philosopher who follows the socratic school, valuing more the questioning method than the proposition of answers or solutions to the problems at hand. His view regarding modern technology is a pessimistic one, qualifying it as dogmatic, authoritarian and inevitably overpowering the human race — he doesn't believe it to be a neutral force like Ortega does. His study is based on the first-person perspective and his, therefore, classified as a phenomenological approach on the subject.

The last thinker from the Humanities Philosophy of Technology to be mentioned in this brief survey is Jacques Ellul, a French philosopher who lived between 1912 and 1994 and that maintains Heidegger's pessimistic tone. Much like Heidegger, Ellul elects modern technology, and not capital or the economy, as the dominant force in the development of the world and he defines it as the sum of all methods rationally developed aiming at absolute efficiency in every domain of human activity, [2]. He distinguishes between *technical operations*, the technology limited by its context of use, and the *technical phenomenon*, the essence of modern technology, the form of making and using artifacts which

tends to dominate and absorb all other forms of human activity, similar to the social manifestation of Heidegger's Ge-stell. In Ellul's view, the problems created by technology are only dealt with upon the creation of more technology which seems to increase and develop according to its own laws, uncontrollable, spreading its influence to every area of human activity in what can be described as a *technological determinism*.

As it was seen, for instance with Dessauer or Ortega, there isn't always a very defined border dividing engineering and humanities thinkers. Some attempts at joining the two different sides were made along history, like the ones of John Dewey and Don Ihde. In the following section the most relevant bridge between the engineering and the humanities branches, in the scope of this work, will be presented.

5 Marxism, a bridge between different perspectives

Capitalism's critique, the most important part in Karl Marx's thought, is endowed with a profound philosophical analysis of technology. Marx devotes an entire chapter, chapter XV, of his 1867 main work *Capital*, [17], to this subject. This analysis can be regarded as one of the most relevant bridges built to connect the engineering and the humanities schools of thought in the Philosophy of Technology.

Karl Marx, who lived in the XIX century between the years 1818 and 1883, was a contemporary of Ernst Kapp and they both shared many political views. Even their academic paths exhibit relevant similarities. Both of them can be regarded as interpreters of Hegel's thought, but while Kapp did so in regard of modern geography, Marx was influenced by the new discipline of sociology and by economics.

The *Lordship and Bondage* passage from Hegel's *Phenomenology of Spirit*, [8], is of particular relevance. Also known as the *master-slave relationship*, it is a key element in Hegel's philosophical system, a fundamental governing premisse of all social relations. It can be interpreted in the following points: the lordship (master) affirms his dignity and frees himself from nature by demanding the bondsman (slave) to supply all his needs; in order to do so, the bondsman under-

takes technological work and «realizes that it is precisely in his work wherein he seemed to have only an alienated existence that he acquires a mind of his own», «[t]rough work (...) the bondsman becomes conscious of what he truly is» [8], that is, he acknowledges his own dignity and that he can transform the world, less noble than he is; from such epiphany, a drive for technological progress is created, which can also free the slave from the physical environment and create an ideal society of free and equal citizens, «the whole of objective being», [8].

Marx considers Hegel's proposition and adds the idea, taken from utopian socialists, that technology *can* promote human welfare but, in order to do so, social reorganization, not a rhetorical but an effective one, must be undertook. In order to devise such a reordering of society, it is fundamental, in Marx's view, to proceed with a thorough study of the production process which is more than just technical. The basic premiss of the marxist analysis of the production process can be found right in the beginning of the *Theses on Feuerbach*, [18], where human life is described as a «sensuous activity, practice» and not just an object of contemplation like materialists believed. This activity extracts certain materials from nature and transforms them for particular human needs. In view of this, Marx considers the capitalist world as «an immense accumulation of commodities», [17], instead of a set of ideas, as idealist philosophers advocated, with the «single commodity» being its unit element. Hence, the analysis of this single commodity constitutes the starting point of his critique.

For Marx, the first fundamental mistakes of modern economy are failing to recognize the social nature of the production processes and that the individual commodities, the consumer products, are not independent from those processes. At this point, Marx emends Hegel's theory: he replaces the general, sometimes spiritual, concept of work in Hegel with the concept of real work: real work is key to human achievement and social transformation. The marxist concept of *labour* can be seen as a general concept that includes technology and technological development, related to production and social organization. In the beginning of chapter VII of [17], Marx describes it as:

Labour is, in the first place, a process in which both man and Nature participate, and in which man of his own accord starts, regulates, and controls the material re-actions between himself and Nature. He opposes himself to Nature as one of her own forces, setting in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate Nature's productions in a form adapted to his own wants. By thus acting on the external world and changing it, he at the same time changes his own nature.

There is something ontological in the short passage above. Work is no mere human activity, it is an essence, a purpose revealed in Man's ever struggle against hostile nature in the context of his larger destiny of humanizing the world, a process where Man and Nature come together as a whole. In that path, labour is revealed not to be a simple tool either, changing man's nature in the process. Moreover, labour is seen as the primordial elementary factor of production, as the other elementary factors, the material, that is, the «subject of the work», and the instruments of labour, are always the result of some previous production process: «[a]ll raw material is the subject of labour, but not every subject of labour is raw material», [17]. Therefore, what is crucial is not the products produced and what instruments were involved but the production processes themselves. Those who control the processes, the *bourgeois*, control the wealth of society.

When studying Marx's views on technology, one should never separate them from the broader aim in his theory: to produce a *critique of political economy*, as it clearly states the "Kantian" subtitle of his work *Capital*, [17], to expose the fundamental flaws and contradictions of capitalism. From what was referred above, it was natural for Marx to conclude that political economy had been linked to class interests and, therefore, been unable to release the immense liberating potential that modern technology contains in itself towards, as Hegel's predicted, the creation of a new and ideal society of true freedom and equality. Hence, in order to liberate political economy from its bourgeois domination, Marx starts a new analysis of the production process, examining the way that instruments of labour are converted from tools into machines and the way machines themselves tend to be organized in complex production systems. Marx's conclusion is that modern technology tends to diminish the worker, to take

away his power, control and influence over the production process, reducing him to a mere operating function, equal, interchangeable and replaceable in the context of the autonomous factory. While in the past the worker was a crucial part of the production process as he possessed a kind of fundamental knowledge not easily obtained, the factory worker is just someone that performs a sequence of simple, easy to learn tasks with minimal connection to the production process itself.

These conclusions also emerge from Marx's analysis of the division of labour. The mechanization of technology is connected to the mechanization of the work force: starting with the division of labour into simple tasks, this process of simplification allowed machines to evolve and develop. This resulted in what Marx portrays as the alienation and physical degradation of the worker in the production process and it is deeply connected to the enhancing of the profit in the modern economy. Like it is written in the beginning of chapter XV of [17]:

> *John Suart Mill says in his Principles of Political Economy: "It is questionable if all the mechanical inventions yet made have lightened the day's toil of any human being." That is, however, by no means the aim of the capitalistic application of machinery. Like every other increase in the productiveness of labour, machinery is intended to cheapen commodities, and, by shortening that portion of the working-day, in which the labourer works for himself, to lengthen the other portion that he gives, without an equivalent, to the capitalist. In short, it is a means for producing surplus-value.*

Indeed, modern economy treats labour as a mere input in its exchange-values dynamics. Like materials, for instance, labour is seen just as a cost in the production process instead of an element deeply connected to the global social engine that drives the economy. In view of this, while the market behavior as a whole cannot be controlled, technology emerges as the most effective way to bring down labour costs and keep them under sustained pressure, this way allowing the production owners to keep increasing and maximizing their profits.

Nevertheless, production is seen as the large purpose of human nature, its

ultimate starting point and the predominant factor in the analysis of the species — productivity is the species essence. The human being, in Marxist view, is a producer, an animal *laboraus*, whose goal and fulfillment is to remake hostile nature into a humanized world, a utopian perfection, as Hegel predicted. In this way, considering technology as an essencial component in human purpose, Marx endows modern technology with an ontological ingredient.

In the thought of Marx technology has, thus, an ambivalent nature or potential. Just as it plays a crucial role in the problem of industrial capitalism, as it was determined by Marx's production process analysis, which was described above, it will also play an equally crucial role in the creation of a better version of society: Marx admires modern machinery as he sees in it the potential to change the world for the better. In the so-called *socialist* society, socialized technology would have the power to eliminate scarcity from the face of the planet and, moreover, to put an end to, what he called, the metaphysical alienation that has challenged philosophers. Technology is, therefore, seen as being capable to accomplish what philosophy and religion have failed to achieve in human history, allowing humanity to affirm itself in the real world and not just in the mind or spiritual realm. It does this by humanizing the world, making it a reflection of human powers. It is a kind of revealing, not in the same way as Heidegger's, but one that extends from humanity as a whole to the individual. While under capitalist economy, where individuals own the means of production, workers are always «wage-slaves» in the production process, in a communist society, where the means of production are no longer privately owned, a worker can freely chose between a variety of equalized jobs. This will allow each individual to chose his true calling and achieve professional accomplishment, as he can even do one job in one day and another in the following: «thus makes it possible for me to do one thing today and another tomorrow», [18]. In this way, modern technology can allow true human freedom.

6   Some considerations and further developments

Marxism analyses of technology offers, through its concept of labour, a conciliating perspective between the two schools of Philosophy of Technology sur-

veyed in Section 3. On the one hand, Marxism performs a thorough analysis of technology itself, its constituent elements and its processes within industrial production. From this analysis, Marx derives consequences, sometimes dramatic, on human life at the individual or collective level. This approach can be identified with Engineering Philosophy of Technology line of thought, like it was observed in Section 4. Particularly, there are strong affinities with the thought of Marx's contemporary Ernst Kapp. For instance, we can find Kapp's inner colonization concept well within Marx's thought. On the other hand, Marx extends its analysis on technology to a deeper, ontological plane. He identifies it as a purpose, a revealing of humanity's essence and calling and a way to humanize the world, creating a truly free society of equal citizens over the constrains of the hostile environment. It is a revealing but in a very different way than Heidegger's proposition. There is something of Heidegger's Ge-stell or Ellul's technical phenomenon involved, but there is also a firm rejection of a pessimist attitude towards modern technology, though recognizing its dual potential.

As it was underlined in Section 5, modern technology has both the potential to serve capitalist exploitation of human labour, reducing the individual to a mere replaceable piece in the production process, ever lowering its value and cost in the profit-chain, and also to serve a communist economy, freeing human labour to develop itself in any branch of activity it wishes, attaining life fulfillment in a rather platonic metaphysical interpretation of human life. We can, therefore, propose the following philosophical interpretation of technology. While we made abundantly clear, in Section 2, that technology is *not* just a tool or a means to an end, that it transforms human lives on a physical and mental level, modifying our cognitive constructs, our way of thinking and so on, it is also clear that it does not affect everyone in the same manner. Under modern society, where some variation of capitalist economy is implemented, the effects of technology and innovation contribute to the accumulation of profit like never before in human history allowing a small fraction of the population to live under privileged conditions while the majority of the population struggles to secure a job to pay only for their basic needs, always facing the permanent threat of replacement by other humans or by technological advance. It's undeniable that the effect of modern technology on the lives of the second group is

very different from the effect on the first group.

Additionally, it is rather naive to blindly advocate for technology determinism, like Heidegger or Ellul do, that is, to believe that there is an inorganic will, a non-human volition that exists within modern technology and that determines its own path and development. It seems to be true that technology's effects on human life have a certain degree of uncontrollability and are somehow unexpected. Human history is also abundant in examples where technological failure was addressed with the development of new forms of technology in what seems to be a never-ending cyclic path. However, to disregard the human touch in the process and the human choice that keeps presenting itself at every instance of this path seems to be plain irrational. Ellul, who lived a century later than Marx, completely misses the point of Marxism, in my opinion, when he referred that, if Marx had lived during the twentieth century, he would have replaced capital with technology as the dominant driving force in human societies. Every artifact developed, every piece of modern technology, contains a precise human intention behind it. It serves a purpose, although the consequences may be undetermined. Moreover, there is the irrefutable question of choice: every technological development can be used in, at least, two very different ways, just as radiation can be used to cure or to destroy. The way we use it is undeniably a matter of our own choice. Like Marx points out, technology can be used as effectively for human exploitation, in the context of a profit-driven capitalist economy, or for human freedom and species achievement, in the context of a socialized economy. It can make workers struggle more and more for work and stable income, or it could as easily free them from tight schedules, lighten their work's physical demands and provide more time and possibility for family, educational, cultural and personal growth. To deny this evidence doesn't seem to be reasonable in the same way it is not rational to disregard the obvious responsibilities of the economic system in the process while, at the same time, adding all the responsibilities of human development to an invisible, intangible, omniscient, omnipotent, god-like technological volition.

Marxist ideas naturally produced an abundant intellectual heritage. Jürgen Habermas, for instance, derived his own social theory from marxist roots, focusing on communication and interpretation as a guide for development, [7]. Herbert Marcuse, [16], argues for deep transformations in science and technol-

ogy and his student, William Leiss, [15], defended that the states, that is, the governments, should actively assist their citizens to empower them with the knowledge to use technology in mass quantities and to help them understand the choices in play. The main idea behind these neo-marxist approaches is that informed citizenship and enlightened public policies are the true antidotes for the technological fatalism and oppression Heidegger's phenomenology warned us about.

The transition between the millennia brought us, however, a different type of critique of Heidegger's pessimistic phenomenology. In the end of the twentieth century, Don Ihde, [10, 11], developed a line of thought (part of the so-called *empirical turn* in the approaches regarding the Philosophy of Technology), that he called postphenomenology, which views technology not as a threat to humanity, but as an integral part of it. Postphenomenologists, like Ihde or, more recently, Peter Verbeek, try to understand technology's essential role in human life in what constitutes a pragmatic approach that also involves phenomenology and hermeneutics. In this sense, postphenomenology is not very different from traditional phenomenology as it sees in technology the same kind of driving invisible force, independent from humanity, neglecting the importance of social dynamics in the whole technological evolution process. In view of this, postphenomenology cannot stand as a true alternative to marxism as a broad theory that connects different perspectives as it's unable to provide a holistic and comprehensive answer to the many challenges technological development presents. Hence, postphenomenology becomes an easy target to criticism of either neo-marxists or socialist thinkers, like Marcuse, or other lines of thought like the post-structuralism of Michel Foucault.

One of the most relevant criticisms with regard to the postphenomenology line of thought comes from the American philosopher Andrew Feenberg and his instrumentalization theory, [4]. Clearly inspired by Marx, Feenberg defends social relations and social choices as critical concepts in the definition of the evolution of existing technology, establishing an intimate relation between technology, politics and democracy. It is the social relations ever present in every aspect of human activity, and not some kind of invisible spirit endowed with technological volition, that truly govern the process of technological development. Heidegger's Ge-stell or Ellul's technical phenomenon are, therefore,

nothing but illusions promoted by a political system that drives people away from the technological processes and ownership, promoting capitalist exploitation and the submission to an expanding consumption society. Instead, politics could play a decisive role to empower the populations regarding technology, like Leiss defended, and put technological development at the service of improving general living conditions and the progress of mankind as a whole.

Surely, there is much left to say about the questions raised in this short essay. Philosophy of Science and Technology is nowadays one of the most exciting and productive fields of Philosophy and the new technological developments never cease to challenge us with new problems never before considered. Social media, self-learning algorithms, adaptable technology, artificial intelligence are just a few of the hot topics that raise ethical and moral concerns which used to exist only in the domain of the most imaginative science fiction pages and, indeed, the development of modern technology often seems to be completely out of our control, transforming our lives, routines and social dynamics. The focus of this work, however, was to reject this predestination some philosophers seem to be resigned to and Marxism provides a solid background to have another take on the subject. At the source of every technological development there is a basic human choice but that choice is not to be made by the average man but, instead, by just a few of us that hold the power to make those decisions. Clearly, technology cannot be seen as a mere means to an end, as it affects and transforms the lives of every person under its influence. However, it does not affect everyone in the same way and the ones in the higher positions of power, the ones that are able to make the political decisions and to influence the masses have a high degree of control over this phenomenon. To understand that there is a choice to be made, different paths that can be taken, constitutes just the first step in reclaiming the power of humanity over technology. It is in the development of an educated and cultured mind, to be able to fully understand the consequences of each choice, regarding the set of ethical and moral values which are meaningful for us, that lies the significant change humanity has to undertake. If that is to happen, then truly revolutionary transformations on political, social and cultural levels are necessarily on their way.

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