

Marx, Automation and the Future of Work

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ABSTRACT

The ever-increasing use of automation technologies in the manufacturing process has again raised concerns about the future of work. A considerable number of left-wing thinkers argue that, with the wave of automation, we see a dissolution of the foundations of a work-based capitalist society, and that a new society has emerged spontaneously. Marx's studies have been referenced, more or less, in most of these analyses. Efforts to base this thesis that we are moving into a post-work society on Marx are highly speculative. In Marx's analysis, automation and proletarianisation are two facets in the process of accumulation of capital that function together. A small number of workers and technology-intensive manufacturing in some sectors make labour-intensive production necessary in other sectors and countries. Today's available data and trends also indicate that Marx's analysis of automation in the context of accumulation of capital is still applicable.

KEYWORDS

Post-work, automation, proletarianisation, fully automated society, technological unemployment

Introduction

New advances in artificial intelligence and robotics have substantially increased the perception, logical operation, and action capacity of machines. Automation has led to significant changes in the production process, altered the sectoral distribution of labour power, eliminated some jobs, promoted new professions and led to the birth of new sectors. This transformation has reignited debates about the automation-employment relationship and the future of work.

There are two main approaches regarding this issue in mainstream literature. The first is the approach that automation, and new technologies in general, are apt to create more jobs than they destroy (Graetz and Michaels, 2015; Dauth et al., 2017; De Backer et al., 2018). The second is the thesis that the new wave of automation is different from previous waves, in that it does not create enough new jobs, and current jobs are rapidly disappearing (Frey and Osborne, 2013; Acemoglu and Restrepo, 2017; David, 2017; Chiacchio et al., 2018).

There are also different non-mainstream viewpoints on this debate. Some believe that technological unemployment will increase further due to automation and that poverty and other social problems caused by this will contribute to public opposition against capitalism. Those who refer to Marx in this context argue that the labour power employed in the production process, and therefore the amount of surplus-value produced, is shrinking; thus, capitalism is pursuing a path to its own collapse (de Mattos, 2018).

Another approach argues that the foundations of a capitalist society based on work are shaken by automation, and a post-work society is emerging (Mason, 2015; Srnicek and Williams, 2015;

Bastani, 2019; Danaher, 2019; Frase, 2019).¹ This means a form of society that is fully automated without workers. Accordingly, with automation, human labour becomes increasingly insignificant in economic activity, while the working class becomes smaller and marginalised.

A significant amount of critical literature references Marx's work. Yet most of these references to Marx are partial. Marx's emphasis on capital's tendency to develop the means of production and make savings on labour costs is highlighted one-sidedly. In fact, as Marx stated, this trend is only one aspect of the accumulation of capital. This one-sided emphasis creates a completely false picture of Marx's analysis regarding automation.

This article primarily aims to present Marx's views on the relationships among automation, employment, and technological unemployment in the context of capital accumulation, and to critically review inaccurate assessments on this issue. The second section below (Different Readings of Marx's Analysis on Automation) summarises the main thinkers who came to varied conclusions about automation despite all referencing Marx. The third section, Full Automation and Collapse in *Grundrisse*, will address frequently referenced views of Marx's from *Grundrisse* and their differing interpretations. In the fourth section (Accumulation of Capital, Automation, and Unemployment), it will be argued that the automation, unemployment and proletarianisation processes advance together. The fifth section, Communism and Full Automation, discusses the suggestion that full automation and a profound reduction in total working time are possible solely in a society in which capitalist relations of production are eliminated. This study concludes that Marx's analysis does not anticipate capitalism without workers, but instead assumes that increased automation goes hand-in-hand with increased proletarianisation.

Different Readings of Marx's Analysis on Automation

Although they all refer to Marx when analysing the relationship between automation and employment, various thinkers came to different conclusions.

Research conducted on the topic of robotics and artificial intelligence after the Second World War gave many thinkers the impression that labour is no longer the decisive force and that the world has been transformed into an "information society" based on the information and service sector (Brzezinski, 1970; Machlup, 1972; Bell, 1973; Toffler, 1992; Drucker, 1993; Castell, 2008). This includes the argument that the working class has shrunk in size and became a marginal class, with the spread of technology. The mistaken and traditional approach limiting the working class to those who work only in the industrial sector (Poulantzas, 2013) and the relative reduction in the number of industrial workers in total employment in the West has been instrumental in strengthening this view. French thinker Andre Gorz (1982) presented this idea openly and proclaimed the end of the working class in his book, *Farewell to the Working Class*.

Automation was a hot topic of discussion among Marxists during this period. By referring to the labour theory of value, Morris-Suzuki (2017[1984]) argued that even if full automation is not possible in the capitalist mode of production, it is possible to get close to this, by shifting the value-production process from production to innovation (software). Although some Marxists put forward different ideas in the context of the "debates on class", most argued that, in general, the working class was growing alongside automation and that this trend would continue (see Mandel, 1999).

¹ Unlike mainstream thinkers, post-work society theorists view this situation positively, suggesting that we are heading towards post-market and post-capitalist society, with reference to some of Marx's texts in *Grundrisse* (1979[1858]).

In the 1980s and 1990s, when factories started to use robots extensively, post-work society theories, as well as “post-industrial society” and “Information Society” theories, became more prevalent (Bloomfield, 2007; Rifkin, 1995; Aronowitz and DiFazio, 1996). In their book *The Jobless Future*, Aronowitz and DiFazio stated that high unemployment rates had become permanent and there was no possibility of creating enough new jobs. By challenging work dogma, the authors proposed a new policy for a post-work society. In his famous book, *The End of Work*, written in 1995, Jeremy Rifkin argued that a society constructed on the basis of work was in decline. He stated that, for the first time in history, human labour was systematically excluded from the production process through automation. He said that, in the whole industrialised world, work would gradually decline and end, probably in less than a century. Intelligent machines would replace people in countless jobs, dragging millions of blue and white collar workers into unemployment or, worse, the free bread line (Rifkin, 1995). In a less famous book published in 1995, *The Automated Society*, Masse Bloomfield (2007) argued that in the evolution of humanity, the next step is automated society.

The most notable of recent post-work studies may be Paul Mason’s book *Post-Capitalism: A Guide to Our Future*, published in 2015. According to Mason (2015), today’s capitalism causes the destruction of many jobs through automation and it cannot create enough new jobs. Mason’s sources for jobs lost through automation are based on mainstream studies. However, Mason goes beyond the claim that some jobs are at stake. He argues that the activity of *work*, which defines capitalism as a whole, is losing its centrality in terms of both exploitation and resistance. According to Mason, capitalism is already dissolving and a post-capitalist society is emerging.

As we have seen, information technology expels labour from production, destroys pricing mechanisms and promotes non-market forms of exchange. Ultimately, it will erode the link between labour and value altogether. (Mason, 2015: 179)

According to Aaron Bastani (2019: 224-236), who agrees with Mason that jobs are being completely destroyed by automation, the emerging post-capitalist society is a kind of communism: *Fully Automated Luxury Communism*. Providing universal basic services, planning centrally, controlling the speculative economy, and socialising the market through cooperatives are some of the measures necessary for this transition.

In a study referring to Marx’s historical materialist method, Silva de Mattos (2018) suggests that jobs have disappeared with artificial intelligence and automation, and we have been moving towards an almost jobless society. Stressing that new possibilities arise with the development of the means of production while moving forward into an unemployed society, de Mattos describes possible alternatives as a kind of capitalism in which elites take the necessary transitional measures, or a socialist or social-democratic order will be established after the revolution.

According to John Danaher (2019), people who are freed from the most hated jobs because of new technologies should happily welcome this reality because, although there are some risks, automation has made new utopias possible in which people are freed from work.

Srnicek and Williams (2015), among the most important representatives of accelerationism, argued in their book *Inventing the Future* that the infrastructure for communism should be prepared by encouraging the current tendencies of capitalism. Accordingly, supporting automation that eliminates jobs and demanding its acceleration would mean the disintegration and collapse of capitalism based on surplus value production.

Against the claim that automation, and perhaps capitalism, is in the process of extinction, thinkers inspired by Marx’s analysis of capital have come to contrasting conclusions.

For example, Kim Moody (2018) emphasised that, owing to decreasing productivity growth, automation applications are not as widespread and fast as claimed. According to him, profitability

is the determinant in the implementation of automation, not the susceptibility of jobs to automation as techno-futurists argue. Therefore, many jobs are not automated, even when it is technically possible.

Martin Upchurch (2016), on the other hand, references Marx and provides a reminder that information, communication and automation technologies are not neutral agents, but are used by capitalists as an element of exploitative labour practices and capital accumulation.

Aaron Benanav (2019: n.p.) also stated that, despite the relative decrease in industrial employment, “the service sector will absorb job losses and new labour market entrants”, but “only by increasing income inequality, leading us further and further into the post-industrial doldrums”. Examining unemployment rates in several countries, Benanav determined that there is no long-term technological unemployment, and unemployment which increases during economic crisis periods returns to its pre-crisis levels after a certain period of time.

Full Automation and Collapse in *Grundrisse*

One of Marx’s most frequently referenced studies, especially in post-work society theories, is his famous text called *The Fragment on Machines*, one part of *Grundrisse*.

In his book *Postcapitalism*, Paul Mason argues that a society dominated by information and automation in the production process moves away from being work-based and that information disrupts the price and value mechanism, thereby leading the market to collapse. Mason (2016) states that this argument overlaps with the ideas mentioned in *The Fragment on Machines*.

Marx wrote his work, known as *Grundrisse*, largely during the winter of 1857/8 in London. He wrote it in German, not for publication, but to provide himself clarity of mind. Marx did not revise it after he wrote it, and Engels did not even mention its existence in any of his texts (Tonak, 2013).

In *Grundrisse*, Marx did not complete the set of concepts he used in *Capital* (1867). The abstract-concrete labour distinction had not been systematised, and the concept of socially necessary labour time had not yet come up. Although it is stated in *Grundrisse* that some part of capital has transferred its value to the product, and some transferred more than its own value to the product, the distinction between variable and constant capital had not been fully clarified (Narin, 2017).

The intellectual exercises contained in *The Fragment on Machines* have been referenced by later commentators in support of the claim of full automation and spontaneous collapse of capitalism. Marx states as follows:

Its presupposition is – and remains – the mass of direct labour time, the quantity of labour employed, as the determinant factor in the production of wealth. But to the degree that large industry develops, the creation of real wealth comes to depend less on labour time and on the amount of labour employed than on the power of the agencies set in motion during labour time, whose “powerful effectiveness” is itself in turn out of all proportion to the direct labour time spent on their production, but depends rather on the general state of science and on the progress of technology, or the application of this science to production. ... He steps to the side of the production process instead of being its chief actor. ... In fact, however, they are the material conditions to blow this foundation sky-high. (Marx, 1979: 643)

This is a condition of high-level automation, in other words, almost full automation. Since capital based on the exploitation of living labour in such a situation loses its ground, it prepares the dissolution of the mode of production that it dominates.

Marx, elaborating his assumption, states:

As soon as labour in the direct form has ceased to be the great well-spring of wealth, labour time

ceases and must cease to be its measure, and hence exchange value [must cease to be the measure] of use-value. The surplus labour of the mass has ceased to be the condition for the development of general wealth ... With that, production based on exchange value breaks down, and the direct, material production process is stripped of the form of penury and antithesis. (Marx, 2003: 175)

From these statements, while Mason concludes that capitalism has been waning, the post-autonomist authors assume that the law of value has been collapsing (Negri, 2006; Vercellone, 2010; Virno, 2013). However, Marx emphasises here that a paradoxical process underlines the form of value on the one hand, and on the other, continues to impose the form of value. It is also possible to see this integrity in the following part of the same paragraph:

Capital itself is the moving contradiction, [in] that it presses to reduce labour time to a minimum, while it posits labour time, on the other side, as the sole measure and source of wealth. Hence it diminishes labour time in the necessary form so as to increase it in the superfluous form; hence posits the superfluous in growing measure as a condition – a question of life or death – for the necessary. On the one side, then, it calls to life all the powers of science and of nature, as of social combination and of social intercourse, in order to make the creation of wealth independent (relatively) of the labour time employed on it. On the other side, it wants to use labour time as the measuring rod for the giant social forces thereby created, and to confine them within the limits required to maintain the already created value as value. (Marx, 1979: 653)

The reduction of labour in the production process on the one hand, and the obligation to “measure these created giant social forces by labour time” on the other, are expressed as contradictory and struggling elements of the same process. This is not a spontaneous collapse, but rather the emergence of the conditions of collapse.

Still, it should be acknowledged that there are some uncertainties in these passages, and the most important one is the assumption of full automation under the conditions of capitalism. Considering Marx’s thought experiment, it seems that the production process moving towards full automation was considered independently of the accumulation of capital. Marx was aware of this, however. In a chapter in which he addressed the problem implicitly, he emphasised that the advance to full automation in a particular sector and the decrease in labour power are balanced by labour in another sector, thus ensuring social reproduction of labour power:

... while this elevation of direct labour into social labour appears as a reduction of individual labour to the level of helplessness in face of the communality [*Gemeinsamkeit*] represented by and concentrated in capital; so does it now appear, in another respect, as a quality of circulating capital, to maintain labour in one branch of production by means of coexisting labour in another. (Marx, 2003: 170)

At this point, Marx includes the total accumulation of capital into the analysis and adds the following to the above quote: “These last two aspects actually belong to accumulation” (Marx, 2003: 171).

However, post-work-society theorists and post-autonomist writers who strain interpretation to refer to Marx agree that Marx did not make such an analysis elsewhere, nor did he move it to *Capital*:

Why didn’t Marx pursue this idea more widely? Why does the general intellect disappear as a concept except on this one unpublished page? Why does this model of the market mechanism being dissolved by social knowledge get lost in the writing of *Capital*? (Mason, 2016: 196)

Grundrisse – which was published relatively late, translated into English only in 1973 – is a work in which Marx expresses his most extraordinary ideas and provides his best hints to the present day, according to some analysts (Negri, 2006; Virno, 2013). Yet *Grundrisse* is a preparatory work for *Capital*. It is pretty easy, while reading *Grundrisse*, to witness Marx actively exploring, taking notes, criticising, developing and systemising his own views. Although this is a considerably rich source that reflects Marx’s critique of political economy and his own perspective, it is worth recalling that

it is a text left behind by Marx. Although the titles of the subsections give the impression at first glance that we are faced with a highly inclusive and systematic text, this is not the case. The incomplete state of the whole of *Grundrisse* is due to the fact that some of the texts corresponding to the subheadings have been excessively lengthened, and others have been briefly mentioned or even rarely mentioned. Here, Marx was able to present his formulation only partly. Therefore, it would be more accurate to regard *Grundrisse* as preparatory work for a comprehensive analysis (Tonak, 2013).

Capital Accumulation, Automation, and Unemployment

Apart from some thought experiments in *Grundrisse*, full automation under capitalism and an equivalent level of unemployment covering a large part of the population was not on Marx's agenda. This is because Marx lived in a period during which one of the most significant waves of proletarianisation in history was experienced. Far from the decline of the working class through mechanisation and automation, he witnessed its growth at an enormous pace. Post-work capitalism or capitalism without workers was not an issue or possibility that Marx would consider and criticise in detail. Moreover, most of his contemporaries regarded unemployment related to mechanisation and automation as temporary and insignificant. Faced with this understanding of the issue, Marx tried to explain historically and theoretically that technological unemployment is an inevitable consequence of the capitalist mode of production. He concluded that the working class would gradually grow, not by relying on polemics with the theory of post-work society but on the basis of extending the general analysis of capital.

The concentration of capital, automation, the increase in the organic composition of capital, the relative decline in the number of workers, technological unemployment, and the processes of proletarianisation are different reflections of capital accumulation, and exist together.

Technological unemployment

The origin of the industrial revolution is the machinery that makes it possible for a small number of workers to do the same work that a large number of workers do with tools (Marx, 2000). According to Marx, the use of new technologies is not just a matter of choice for capital. It is an internal tendency of capital to strive to increase (relative) surplus-value. One of the most fundamental consequences of the use of advanced technology in the context of capital accumulation is unemployment: "The working population therefore produces both the accumulation of capital and the means by which it is itself made relatively superfluous; and it does this to an extent which is always increasing" (Marx, 1990: 782).

Capital accumulation, which paves the way for processes to increase employment, also produces the relative surplus population that is not directly involved in the production process. The relative surplus population, or reserve army of workers, means more people than necessary for the accumulation of capital. As a result of increased productivity, more raw materials and machinery are used with less labour power. As the size of the capital accumulation increases, less labour power is needed per unit of capital, and the amount of employed labour decreases due to the increase in productivity in previously invested areas. Capital accumulation increases the demand for labour on the one hand, and on the other hand leaves some labour power unemployed which has been rendered unnecessary by automation, making it "surplus" (Marx, 2000).

This tendency, emphasised by Marx, can be seen as a kind of confirmation of the arguments of post-work theorists. However, this can be challenged. According to Marx, unemployment and

the increase in unemployment, although it may seem like a contradiction, can exist together with the increase in employment.

Business-based automation and employment

The purpose of capital is always to appropriate more surplus-value, requiring investment of an increasingly large amount of capital (Marx, 2003). Accumulation of capital can be achieved if the appropriated surplus value is converted into an additional or new investment. In fiercely competitive conditions, the risk of being eliminated by rival capitalists increases if a capitalist does not convert surplus value into additional or new investment, or the new investment fails.

Sensitivity to automation varies among sectors, even among businesses in the same sector. Still, the general trend is for capital to use more advanced production tools that substitute labour power to reduce unit cost.² Therefore, the constant capital allocated to means of production and raw materials, especially machines, in a business gradually increases compared to the variable capital allocated to workers. This means that in a workplace where, typically, 100 workers were employed, the same amount or more of the product is produced using new robots and fifty workers.

This example reflects one aspect of the trend, and disregards the growth and accumulation trend of capital.

An example similar to one described by Marx (2000) in the first volume of *Capital* is as follows: Let's assume that the average wages of workers in a business are fixed, and 300 workers are paid a total of 3 000 euros (variable capital), and the investment in machinery and raw materials is 9 000 euros (constant capital). The organic composition of capital is three (9 000/3 000). Let's assume that the new machinery replaces 100 workers, so that the value of the *constant* part of the capital soars to 10 000 euros. In this case, the organic composition of capital increased to five (10 000/2 000). In this case, the company increases its dominance in the market with its new technical infrastructure and doubles its production volume. Its investment in constant capital will increase to 20 000 euros and the number of required workers will double (constant capital will also increase to 4 000 euros). Thus, although the number of workers diminishes *relatively* due to the use of advanced machinery, the number of workers will soar to 400 with the growth in investment volume and will increase *in absolute terms* compared to the first case. With the use of more advanced machinery in the production process and the decrease in the relative number of workers, a rise in the absolute number of workers may take place simultaneously.

The e-commerce monopoly Amazon is an excellent example of the growth of capital and the increase in the absolute number of workers. The number of robots Amazon uses in its distribution warehouses and the size of its constant capital have increased extraordinarily in recent years. In some of its warehouses, tasks are performed entirely by robots. However, since the size of the business has grown and the number of warehouses has increased concurrently with the growing number of robots, the number of workers has also grown at an extraordinary pace. While there were 24 300 workers in 2010, this number increased to 1 525 000 in 2023 (Macrotrends, 2024). While the number of robots used in 2015 was about 30 000, this number exceeded 200 000 in 2019 (Kim, 2015; Heater, 2019).

Nevertheless, conflicting examples are also probable when considering individual businesses. With the use of robots, the absolute number of workers can be reduced. The cumulative impact of counter directional trends on the economy will be different in the short and the long term. To understand this impact, it is necessary to go beyond individual capital and examine total capital

² Advanced machines do not necessarily mean the substitution of labour power. In some cases, they help labour power and improve its efficiency.

movement.

Total capital movement and employment

Jobs have been replaced by machines since the industrial revolution. When the first machines were introduced into the production process, thousands of laid-off workers broke machines and set fire to some factories (Hobsbawm, 1952).

According to Marx, although some workers are dismissed as a result of mechanisation, this can lead to an increase in the number of workers in other industries. However, this effect has nothing in common with the so-called theory of compensation (Marx, 2000: 423). Workers who have been laid off can find new jobs only through additional capital investment in new areas (Marx, 2000: 421). This is possible by turning the surplus-value generated into new investments – in other words, by expanded reproduction of capital. Additional or new investments can be made to grow existing businesses, open up new businesses in existing sectors, or invest in new sectors.

Turning the surplus-value resulting from economic activity into reinvestment is an indispensable element of the capitalist mode of production. However, more or less stable growth can be achieved in the capitalist economy by making new investments. Therefore, almost all governments offer various incentives to attract investment to their countries (Rodriguez-Pose and Arbix, 2001; Christiancen et al., 2003; Keho, 2016). Investments are essential not only in production, but also in finance. In order for people's small savings to be pooled in financial capital institutions and turned into loans or other financial instruments, the practice of financial "inclusion" and "literacy" is swiftly becoming widespread (Bryan et al., 2009).

The need for saving and growth forces capital to boost its investments in existing sectors. This is followed by capital using more advanced means of production and reducing the relative number of workers. However, the total number of workers tends to increase. Marx states as follows:

The same development of the productiveness of social labour, the same laws which express themselves in a relative decrease of variable as compared to total capital, and in the thereby facilitated accumulation, while this accumulation in its turn becomes a starting-point for the further development of the productiveness and for a further relative decrease of variable capital – this same development manifests itself, aside from temporary fluctuations, in a progressive increase of the total employed labour-power and a progressive increase of the absolute mass of surplus-value, and hence of profit. (Marx, 2003: 195)

What Marx points out here are the two main elements of the accumulation of capital. The first is the fact that profit-seeking capital uses more advanced means of production to increase the mass of surplus value, resulting in a decrease in the number of workers employed and in the corresponding variable capital. Second, the necessity for capital to appropriate more surplus value again forces it to increase the size of its investments, which in turn encourages an increase in the absolute number of workers. The main shortcoming of the approaches that identify the advent of a post-work society by referencing Marx today is that they recognise one of these counter-trends in accumulation of capital that are intertwined and advancing together, but disregard the other. As Marx points out, the relative decline in the number of workers is not due to an absolute decrease, but due to the fact that the growth in the size of capital is much more significant and faster than the rise in the amount of labour power (Kosar, 2022).

Capital's domination of the new working masses can take place in different ways. The rapid accumulation of capital in a particular sector increases production in many sectors associated with it and stimulates new jobs.

For example, the rapid rise in the textile industry not only increased textile jobs, but also led to a considerable increase in mine production and works, just as in cotton production, cotton gin

and cotton spinning. The textile products reaching a global scale and the expansion of the world market increased sea and rail transportation and jobs needed to manufacture these vehicles (Marx, 2000). However, the accumulation and concentration of capital conditions the emergence of new sectors and investment areas or the opening up of previously uncommodified areas to investments.

Historical developments have also confirmed Marx's vision in this regard. Since the accumulation of capital has reached an enormous size, the absolute number of workers has risen rapidly around the world. Despite the notable increase in robot use and advances in artificial intelligence technologies over the past thirty years, the number of workers worldwide was about one billion in 1990 and surpassed 1.75 billion in 2021 (Ness, 2018; Statista, 2023). The risk in the short and medium term is not that jobs will disappear, but that most of the new jobs will be precarious and low-paid.

Counter-trends, contradictions and instabilities

These trends mentioned by Marx are not natural processes that advance uniformly and linearly. There are other factors and trends in the face of these tendencies. The whole process advances in contradiction and instability. The automation and proletarianisation trends stated by Marx are effective in the long term, and the counter-trends can be effective in the short and middle term.

Although automation is an inherent tendency of capital, various factors also restrict it. These can be divided into two kinds: technical and economic. From a technical point of view, the tendency towards automation among sectors is quite divergent, and, as Marx pointed out, some jobs are more inclined to automation while others are less suited. From an economic point of view, increasing profits underlies the capitalist practice of automation over and above other motivations. Automation is more sensitive to profitability than technical possibilities (Moody, 2018). Once labour power becomes relatively cheap through using machinery, the capitalist will prefer to employ workers instead of machinery. For this reason, Marx (2000) states that when machines were invented in England they were not used in England but in North America.

Furthermore, according to Marx (2000), with the use of new technologies in the production process, the size of the constant capital allocated to machinery and raw materials increases both in absolute terms and in proportion to the variable capital allocated to labour power. Marx called this rate the organic composition of capital. Therefore, the average rate of profit tends to fall over time. This is discussed in the mainstream literature as a decrease in the rate of productivity growth (Cowen, 2011; Gordon, 2012; Roberts, 2021). This limits new investments and leads to a contraction in employment opportunities.

From the 1990s onwards, it has been observed that the relationship between economic growth and employment has weakened, and in some countries GNP growth has been achieved without a sufficient increase in employment; therefore, this has been called "economic growth without employment" (Bhorat and Oosthuizen, 2006). Such economic growth can be linked to more intensive and longer working hours, a technical renovation of production causing an increase in productivity, a rise in the price of natural resources, or tremendous outsourcing. Employment expansion may be limited or almost non-existent.

During economic recessions, capitalists prefer not to make new investments, and may rather reduce their current production, even sell and lose what they produce. Thus accumulation of capital is undermined for a certain period, the economy shrinks, and employment – especially paid employment – decreases, causing an increase in unemployment.

Although accumulation of capital generally encourages new employment opportunities, the employment of laid-off workers due to intensive automation in other jobs and sectors may not be possible in the short term, or even in the long term. In the case of a worker who loses their job as

a result of automation after working on the automobile production line for many years, it is unlikely that they will be able to find a job within a few months in the software sector, which offers new job opportunities. For this reason, although the general trend of the capitalist mode of production is to create new jobs through new capital investments, technological unemployment persists as a permanent fact.

The impossibility of full automation in capitalism

A concept such as “fully automated capitalism,” referenced to Marx by some commentators today, is entirely incompatible with Marx’s analysis of capital and the labour theory of value. Only labour power produces a surplus value above its own value in the capitalist mode of production (Marx, 2000), and capital is accumulated by appropriating this surplus value. It is unlikely for most or all production to be replaced by robots and artificial intelligence applications because, if that happens, the surplus value, which is the backbone of capital accumulation, will not be created, and this is not possible under the conditions of capitalism.

In relation to full automation, the other aspect of production without workers is the fact that the products manufactured cannot be sold. Even if we acknowledge that robots create surplus value in this inconsistent argument, capitalists cannot realise this surplus value because, under conditions where the produced commodity cannot be sold, it is not possible to realise the surplus value (that is, to confiscate it). A large amount of unsold and accumulated commodities swiftly loses value and turns into a worthless mass. More limited examples of this are witnessed in the crisis of overproduction, as commodities and capital are rapidly devalued.

Even if full automation is implemented in a limited number of businesses for these reasons, this is not a general and typical phenomenon under the conditions of capitalism. A high level of automation in one sector requires other sectors that employ labour power. High automation in the automotive sector in Germany survives only with the existence of low automation and labour-intensive production in the textile sector in Bangladesh. While in some sectors the number of workers decreases with automation, new jobs emerge in other sectors. This is not a general equilibrium, of course, but a contradictory process that embodies expansion, stagnation and collapse, and where instability is inherent. In this contradictory process, automation and proletarianisation, labour savings and the employment of the wide range of working masses exist together.

Communism and Full Automation

In general, capitalism has developed machinery and the means of production at an extraordinary pace. In the Communist Manifesto, written in 1848, Marx and Engels stated that “The bourgeoisie, during its rule of scarce one hundred years, has created more massive and more colossal productive forces than have all preceding generations together” (Marx and Engels, 2016: 46).

In the hands of the capitalist, machinery enhances labour productivity and makes it easier to put labour under discipline. It is a means of boosting absolute and relative surplus value. It provides some necessary conveniences in people’s daily lives, changing their lifestyles and habits. However, it does not provide an automated solution to poverty, unemployment, unfair distribution of income, gender inequality or many other problems caused by the capitalist mode of production, nor is it used for such a purpose. On the contrary, it is an essential and functional component of the process that creates these problems as one of the critical elements of accumulation of capital and expanded reproduction.

However, robots, artificial intelligence and automation technologies provide the opportunity to meet all the material and spiritual needs of humanity, and the possibility of a society of abundance that will eliminate poverty, misery and deprivations trampling human dignity. When capitalist ownership of the means of production – and technological knowledge – is abolished, and when the ownership of the working class and the entire working people and collective production is established, wealth becomes available for everyone's benefit.

In such a society, the use of technology and automation takes a completely different turn. It becomes possible to use technology, and in particular automation, to reduce work and increase free time, since profitability is no longer the determinant in the implementation of automation. By transforming the relations of production, work itself can be transformed into a self-actualising activity that does not alienate (Sayers, 2005). Through the use of technology in a way that prioritises welfare, people find more free time to enjoy their creative passions in activities of their choice. The pursuit of freer creative activity becomes a priority, replacing the goal of maintaining and strengthening existing business for more profit.

The basis of all human emancipation is to get rid of the long, tiring, monotonous and exhausting work obligation. When the capitalist profit mechanism comes to an end, the main obstacle to the shortening of working hours is removed, and the “realm of freedom” precedes the “realm of necessity” (Marx, 2003). Working eight, ten, twelve, fourteen hours a day is replaced by decreasing working hours. Work can be reduced to a few hours per day.

In communism, the abolition of heavy and non-progressive work becomes a key task. When the relations of exploitation and domination brought about by production for profit and the pursuit of more profits are abolished, a society based on (almost) full automation appears as a real possibility.

Marx's predictions regarding communism and the arguments of post-work theorists regarding the spontaneous emergence of a post-work society under capitalism are quite different. According to Marx, there is no spontaneous transition to communism, and under capitalism, capital's tendency to dominate a larger workforce and its dependence on living labour continues.

Conclusion

As Marx discovered quite early on, the production of technology and its use as an input has become a fundamental component of the capital movement as capital takes over the production process. Capitalists, who need to reduce production costs and increase productivity due to competition, tend to use more advanced means of production. What motivates the development and use of production tools is the surplus profit they receive (relative surplus value) or the monopolistic profit they appropriate through product innovation (Kosar, 2021).

Announcing the end of work with automation, numerous social scientists referenced certain passages of Marx in the *Grundrisse* (Aronowitz and DiFazio, 1996; Mason, 2015; Bastani, 2019). They sought to derive a kind of post-work Marxism from some of Marx's intellectual exercises which were not included in his later work. However, according to Marx, the reduction in the number of workers with automation in individual enterprises is only one aspect of capital accumulation, and the overall results cannot be grasped without evaluating capital accumulation holistically.

While capital tends to reduce the number of workers by replacing workers with advanced machinery, the requirement to accumulate and expand forces capital to make much bigger investments and employ more workers. “To accumulate, is to conquer the world of social wealth, to increase the mass of human beings exploited by him, and thus to extend both the direct and the

indirect sway of the capitalist” (Marx, 2000: 566). However, as Benanav (2019) points out, new jobs, particularly in the service sector, will be low-wage and highly precarious, due to low productivity and slowing economic growth.

The more capital’s size increases, the more it boosts the number of labourers it rules. Although the number of workers in single enterprises with advanced machines has decreased relatively, absolute employment tends to increase with expanding new investments of capital. A small number of workers and technology-intensive manufacturing in some sectors make labour-intensive production necessary and mandatory in other sectors and countries.

The thesis that we are moving into a post-work society since capital uses robots, artificial intelligence, and other automation technologies more intensively is highly speculative and utterly incompatible with Marx’s approach. Not only is post-work capitalism not possible without the exploitation of labour power, which is the basis of the accumulation of capital, but the spontaneous collapse of capitalism through automation does not seem probable either. Post-work theories fail to understand the way capitalism works, disregarding present-day capitalism’s trends and the exploitation relations on which it is based.

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