# Governed by digital technology?
## Self-perpetuation and social domination in digital capitalism

*Konstantin Klur and Sarah Nies*

**Konstantin Klur** is a PhD candidate at the Institut für Sozialwissenschaftliche Forschung (ISF) in Munich, Germany.
**Sarah Nies** is Professor of Sociology at the Georg-August University in Goettingen, Germany.

**ABSTRACT**

**Digitalisation is often associated with the domination of technology over humans. This article aims to develop a concept of self-perpetuation that illuminates the relationship between technology and social domination instead of focusing only on technological properties. Drawing on Marx's concept of real subsumption and interviews in industrial companies, we analyse specific forms of self-perpetuation that take place in the digitalised working world. In doing so, we critically examine the diagnosis of digital Taylorism which assumes a comprehensive elimination of the subjectivity of workers. In contrast, we show that digital technology allows for other forms of domination based on the flexibility of living labour.**

> *'As, in religion, man is governed by the products of his own brain, so in capitalistic production, he is governed by the products of his own hand'. (Marx/Engels 1887:438)*

## The unease with (digital) technology

Since the emergence of the first technologies that do not have the character of tools but perform formerly human activities independently, ideas have arisen that machines have

a life of their own. Automation has not only been accompanied by visions of replacing tedious work and overcoming alienating working conditions (for example Blauner, 1954; Touraine, 1955), just as at present, but has also been accompanied by the fear that the new technologies could impose their mute will on humans. Historically, this fear found its practical expression in the destruction of machines, for example, in the Swing Riots of the early 19th century (cf. Noble, 1993; Mueller, 2021), and its theoretical expression in a wide range of works, from progressive (Noble, 1979, 1993; Anders, 1994) to reactionary (Heidegger, 1977). Hence, automation has always been both a utopian vision of a life no longer burdened by work and a horror scenario of total submission to uncontrollable external powers. Digitalisation has boosted both visions. After all, what could better embody the self-perpetuation of technology than, for example, artificial intelligence that hands over decision-making processes to algorithms? The threat of self-perpetuating technologies is omnipresent in the genre of techno-dystopia but has also been taken up in the sociology of work in discussions about the transfer of human areas of competence to technology, as well as the inherent dynamics of self-controlling production systems, machine learning and digital systems in which internal processes are no longer comprehensible from the outside (for example Decker et al., 2017).

Although technical systems are in fact accompanied by non-comprehensible phenomena and emergent properties that can lead to 'massive control and coordination problems' (Malsch & Schulz-Schaeffer, 2007:par. 2.4) and it may therefore be intuitively convincing to conceptualise self-perpetuation of technology as described, such a theorisation conjures up fundamental problems. First, it reinforces the fact that the autonomy and capabilities of new technologies such as artificial intelligence and robotics are often overestimated (Will-Zocholl, 2017; Moody, 2018; Pfeiffer, 2019; Benanav, 2020). Second, the notion of self-perpetuation conceived mainly as an inherent technological dynamic would not add much to existing and broadly discussed concepts such as automation, autonomy and the emergent properties of socio-technical systems (cf. Elder-Vass, 2017). Third, when using the term 'self-perpetuation' to describe only the inherent dynamics of technologies, one runs the risk of attributing powers to machinery which are in fact built into social relations – a fallacy that has not only been famously criticised from a social constructive view in the Social Construction of Technology approach (SCOT) but also from a materialist perspective within the critical sociology of work in discussions about the structure of power relations that are reflected in machinery at work. In that sense, and unlike in techno-dystopian discourses, a critical sociology of work should be less concerned with the domination *by* technology and more about the entanglement of social domination *with* technology.

Guided by questions that arose in the course of an ongoing empirical research project on digitalisation in the industrial sector,[1] we attempt to develop a critical concept of self-perpetuation in the digitalised working world that addresses this relationship between social domination and technology. To achieve this goal in the

following article, we refer to Marx's concept of real subsumption and considerations of technology to discuss how technology as a social product can be inverted into a means of domination that appears as an alien force. In our discussion of relevant changes in the mode of domination in digitalised capitalism, we will further focus on the question of how capital takes possession of living labour by means of digital technology and what specific form self-perpetuation takes here. Guided by the empirical insights that we gained through interviews on different sites of a large automotive and industrial supplier and in two medium-sized companies in electrotechnical sectors, we critically examine the diagnosis of digital Taylorism which assumes a comprehensive elimination of the subjectivity of workers. Contrary to this proposition, we show that digital technology allows for other forms of domination based on the flexibility of living labour in which self-perpetuation gains a new shape.

## Sharpening the concept of 'self-perpetuation'

We will thus begin with the conceptual development of the notion of self-perpetuation by critically examining Karl Marx's theoretical contributions. The term occupies a central position in Marx's work but did not come into English translation on its own: the German *Verselbständigung* is translated here, for instance, as 'character of independence' (Marx & Engels 1887:289), 'become automatic' (ibid:276) or 'isolate' (ibid:245). As we shall see, while this captures some aspects of the term *Verselbständigung*, the decisive point is not clearly made in this translation but is better grasped in the term 'self-perpetuation': if technology self-perpetuates, this does not only mean that it carries out work steps 'independently' or 'automatically' in the technical sense. It also means that it shapes and determines living labour. It not only becomes independent in itself but becomes an independent force against the workers, constraining their possibilities for action. Building on this, we will discuss two aspects of Marx's understanding of self-perpetuation in the following paragraphs. First, as we will show, Marx is not concerned with domination by technology, but with technology as a means of domination. Therefore, the crucial point of self-perpetuation is not that human activities are delegated to technology, but that technology is used as an instrument to subjugate and control living labour. The self-perpetuation of machinery expresses the self-perpetuation of a social principle – that of valorisation. Second, while self-perpetuation does have technical preconditions, Marx does not assume that technology has an immanent character of domination; instead, he is only concerned with the 'capitalist application of machinery' (ibid:261). His claims in this regard have always been wildly contested and we will review them critically in order to analyse self-perpetuation in the digitalised working world.

### Self-perpetuation as a core moment of social domination in capitalism

For a critical conceptualisation of self-perpetuation, one must turn to the relationship between technology and domination. Marx elaborated in his economic writings on the role of technology as a means of domination, trying to show how machinery in large-scale industry deskills living labour subjugates it to the pace of the machine and further

removes the concrete product from the worker so that 'the machine does not free the labourer from work, but deprives the work of all interest' (Marx & Engels, 1887:286). Although a product of the worker's own hands, as machinery becomes the determining factor in the production process, it grows independent of the will of the worker and turns him into an appendage. However, Marx was not interested in a critique of technology *per se*, but of the whole capitalist economy. His analysis of the self-perpetuation of technology can therefore only be understood against the backdrop of the self-perpetuation of the capitalist relations of production. The self-perpetuation of technology relies on the separation of the worker from the means of production because *the fact that workers do not have the power, legally or factually, to dispose of the means of production is the precondition for them to be subjected to these means in the labour process*. Moreover, the self-perpetuation of technology is directly intertwined with the dominance of the principle of valorisation – in itself a man-made yet self-perpetuating principle which exercises its 'mute compulsion' (Mau, 2019) on workers as well as on capitalists.

The self-perpetuation of technology operates on two levels: on a general-social one (general conditions of production as given with the relations of property) and on the level of the specific labour process. This issue addresses Marx's distinction between formal and real subsumption. Historically, formal subsumption has involved a change in property relations, which legally and factually separates the workers from the means of production, but leaves the labour process itself unchanged (Marx, 2010:426; Marx & Engels 1887:360). Real subsumption, on the other hand, denotes how living labour is subjugated to the purposes of capital accumulation and how the 'kind of labour done and the real mode of the entire labour process' (Marx, 2010:426) is materially adapted to the requirements of valorisation (cf. Marx, 2010:428 ff; Marx & Engels, 1887:360 ff; Vercellone, 2007:25). Or, as Søren Mau phrases it, real subsumption is the process whereby 'the valorisation process … meshes with or intervenes in the … material character of the labour process' (Mau, 2019:203).[2] Even though not only technical aspects are relevant for real subsumption (see below, under the heading 'capitalist technology or capitalist application of technology'), Marx pays special attention to machinery in this process, and it is not by chance that he develops the concept on the basis of the development of large-scale industry: 'the character of independence and estrangement which the capitalist mode of production as a whole gives to the instruments of labour and to the product, as against the workman, is developed by means of machinery into a thorough antagonism' (Marx & Engels 1887:289). The crucial point in this argument is however, that nothing entirely new is happening with the emergence of machinery. Rather, with machinery 'capital attempts to achieve by technological means' what it before attempted 'to achieve by social organisation alone'

2   Until the 1980s, the concept of real subsumption was broadly debated in German industrial sociology (cf. Stück, 1978, IfS, 1981; Hartmann, 1985; Schumm, 1989; Brandt, 1990). This debate is omitted here for two reasons. First, it was conducted almost exclusively in German, and hardly any relevant texts were translated into English. Second, the concept's concrete usage, especially on the part of the then Frankfurt Institute for Social Research, was fraught with fundamental problems. Discussing these problems would go beyond the scope of this article. Since, in our opinion, these problems are caused less by Marx's concept of subsumption than by Alfred Sohn-Rethel's wayward use of it, it seems justifiable to bypass this debate in our article as it is mainly based on Marx.

(MacKenzie, 1984:487), which is conditioned by the very structure of capitalist production and property relations.

The effects of machinery on living labour understood as real subsumption by Marx, correspond strongly to Tayloristic principles: through real subsumption, the qualified, 'virtuoso'[3] work of the craftsman is replaced by the 'stupidity of the detail labourer' (Marx & Engels, 1887:249), just as Braverman notes how through Taylor's scientific management 'craftsmanship is destroyed or increasingly emptied of its traditional content' (Braverman, 1974:90). Like the Taylorist mode of work organisation, real subsumption, as described by Marx, goes hand-in-hand with disempowerment, deskilling and the technical subjugation of labour. In 'the modern factory system . . . automaton itself is the subject, and the workmen are merely conscious organs' (Marx & Engels, 1887:284). It is not the workers who apply the machine, but the machine that applies the workers. Although this inversion reflects the underlying property relations, we shall see that the specific form that the self-perpetuation of technology takes for Marx, just like the equation of labour process control with the Taylorist mode of direct control, is a historically limited view on possible forms of real subsumption and the functions of technology.[4]

Even if Marx refers to the historical establishment of a 'specifically capitalist mode of production' (Marx, 2010:428) to elaborate the concept of real subsumption, this is not to be understood as a (past) historical phase but denotes the ever-new attempts of capital to appropriate living labour and transform the labour process for the purpose of valorisation (cf. Schmiede, 1988; Endnotes, 2010; Mau, 2019:195–252). Conceptually, the term thus describes the strategies to secure or increase the production of surplus value, to control living labour and in general to align the material production process with valorisation requirements (Marx, 2010:439). However, and this is also important for the later analysis of digitalisation, there are – again analogously to the control of the labour process – different ways to achieve these goals and, accordingly, there have historically and simultaneously been different modes of real subsumption: as one can learn from Marx himself, control and deskilling are not independent goals of capital, but only means of valorisation. And since skills are 'not always a barrier to valorisation' (MacKenzie, 1984:493) and '[d]irect control over the labour process is not always the best means of valorisation' (ibid.), real subsumption will not always rely on principles associated with Taylorism.

Notwithstanding these observations, Marx's notion of technological self-perpetuation has several points that must be taken into account. First, because Marx conceives of productive forces as a social product, technological self-perpetuation is not

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3   Marx uses the term 'virtuosity' several times, but it is usually replaced by 'skill' or 'special skill' in the English translation (Marx/Engels 1887:239).
4   Early on and most famously, Friedman (1977), Edwards (1979) and Burawoy (1979) confronted Braverman's pathbreaking, albeit one-sided, account of the control problem with alternative analyses of the labour process. For more recent developments in the labour process debate, see, among others, the edited volumes by Thompson and Smith (2010) and Briken et al. (2017). While these authors traced Braverman's one-sided focus on deskilling to Marx, more recent debates emphasise that Marx also had an eye for possible trends in upskilling (Adler, 2007; Vidal, 2018). As will be seen below, we agree with these authors that upskilling should not be understood as an exception and coincidence but requires systematic explanation. Nevertheless, as Vidal also points out, Marx himself saw the deskilling of labour as the dominant tendency.

simply a technical property, but a characteristic of domination under capitalism, in which something man-made confronts workers as an alien and coercive power. Second, technically mediated work requirements, as well as the principle of valorisation, objectified in technology, appear as neutral, quasi-natural inevitabilities. Third, the self-perpetuation of technological artifacts is therefore as real as it is illusory. Because technology becomes an instrument of domination and obstructs control and intervention for workers, the self-perpetuation of technology is very real for them. At the same time, it is illusory insofar as it is in fact a social product of human action which can – in principle – be changed or abolished through human action.

## Capitalist technology or capitalist application of technology?

The character of (digital) technology as a means of domination is a much-discussed topic in critical research on work and labour processes (for example Braverman, 1974; Brandt, 1978; 1990; Hall, 2010; Nuss & Butollo, 2019). While there is agreement on analysing technology as a means of domination, it is rightfully disputed whether this character of domination is due to the way technology is applied or whether it has become inherent, that is, a material property of technology. Even though he does not spare bad words about machinery, Marx himself does not contend against machinery itself – which he regards as stupidity, as he repeatedly emphasises (Marx & Engels 1887:295) – but against the 'capitalist application of machinery' (Marx & Engels 1887:295). Although Marx does not ignore that real subsumption has technical preconditions, he emphasises that the effects of technology cannot be considered as independent of the organisation of labour in which it is embedded. In his view, workers are locked into a system of 'technical necessity' (Marx & Engels 1887:268) only once a 'chain of machines of various' kinds has developed into a 'complex system of machinery' (ibid:263). Therefore, real subsumption is not achieved through technology as such, but only through a certain organisation of the production process.

Thus, even though the accusation of technological determinism misses the core of Marx's theory, his understanding of technology is nevertheless fraught with a fundamental problem. In a bewildering effort to avoid the perception of an intrinsic character of technology's domination, he omitted the historical analysis of the entanglement between technological development and domination. Therefore, he did not pose the question of to what extent the specific shape of technology could itself be 'specifically capitalist' (cf. Giest, 2016:29) or – more generally – how the development, architecture and properties of a specific technology were socially constructed. Despite his critique of domination and exploitation by technological means, like many other thinkers, Marx seems to follow a traditional view of technological development following a path of endogenous progression. In contrast, within the field of Science and Technology Studies (STS) the focus on the Social Construction of Technology has shed light on the social processes that shape not only the deployment of technology but the nature of scientific knowledge and technological innovation itself (for example, Bloor, 1976; Bijker et al., 1987; Oudshoorn & Pinch, 2003). Technology does not evolve purely endogenously but is rather shaped by society, that is, by social mechanisms of closure and the influence of particular social groups. From a different theoretical perspective (but in line with the argument that technology cannot be regarded as something that

evolves along neutral and linear progress), authors in a Marxian tradition theorising the entanglement of dominance and technology have repeatedly criticised Marx's somewhat inconsistent and teleological view of technology.[5] Castoriadis, for example, emphasises that 'the machines in question during the capitalist period are indeed 'intrinsically' capitalist machines. The machines that we are familiar with are not 'neutral' objects which capitalism uses for capitalist ends' (Castoriadis, 1987:357). Marx's conceptualisation of technical developments as detached from capitalism, by contrast, leads to a perception of monolinearity and the inevitability of a certain technological development that has been disproven many times. A famous example in our area of research is by David Noble (1979) who discussed the way that numerical control (NC) prevailed over alternative methods of machine control – especially the record-playback method – in machine tool manufacturing in the 1950s. According to Noble, the decisive factor was not the technical superiority of NC with regard to the problem's solution – the storage of machine sequences on a medium and their retransmission to the machine for the purpose of reproducing a work sequence. Rather, a complex of governmental influence (mediated by investments of the Air Force) and the objective of increased control over reproducibility were crucial for the success of NC, since, in contrast to the record-playback method, the process of recording did not result from the work process itself (Noble, 1979).[6]

In this sense, we presume that social relations in general and, more specifically, relations of production and the principle of valorisation (which includes capital's aim to control living labour) shape the technical properties of machinery and the directions of technological development. Yet, this assertion does not imply that the development and specific uses of technologies have been uncontested or that technology will necessarily function in the intended way. That is to say that not only labour power but also technical artifacts are subjected to real subsumption (Giest, 2016). Technology is not only applied to serve the means of valorisation – which could be defined as formal subsumption of technology – but actually shaped and designed for valorisation and is, therefore, itself the object of real subsumption. Real subsumption affects all productive forces, and these include living labour and technology. A critical engagement with the effects of digital technologies on labour must thus also turn to affordances (Faraj & Azad, 2012) and an investigation of the closure mechanisms that the properties of technology might contain. In STS, the influence on human action exerted through technological materiality has been a recurrent theme (Berlin Script Collective, 2017). Langdon Winner (1980), for example, has famously attributed political qualities to artifacts. Actor Network Theory (ANT) even

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5  For a perspective that explicitly combines the research perspective of the Social Construction of Technology with a feminist-materialistic view see Wajcman (1991; 2017).
6  'Record-playback was, in reality, a multiplier of skill, simply a means of obtaining repeatability. The intelligence of production still came from the machinist who made the tape by producing the first part. Numerical control, however, was based upon an entirely different philosophy of manufacturing. The specifications for a part – the information contained in an engineering blueprint – are first broken down into a mathematical description of the desired path of the cutting tool along up to five axes, and finally into hundreds or thousands of discrete instructions, translated for the economy into a numerical code, which is read and translated into electrical signals for the machine controls. The NC tape, in short, is a means of formally circumventing the role of the machinist as the source of intelligence of production' (Noble, 1979:23).

ascribes – no less famously – to technological objects the status of agents as important as human actors. Independent of the more radical implications of ANT, we can draw on its insights into how technological 'delegation' allows artifacts to take on tasks to direct others in a desired direction (Latour, 1994). In the process of technological innovation and design, visions and predictions about the context, relationships and division of labour are already inscribed in the architecture of any given technology. In other words, technical objects define 'a framework of action' (Akrich, 1992:208) that, while not independent of the actors who deploy and use them, harbours a certain obduracy inscribed into the technical properties. Without denying the inherent logic of workplace processes and the obstinacy of work behaviour, we, thus, presume that workers are confronted with technical artifacts whose properties contain certain prescriptions about the organisational contexts in which they are used and that resist to a certain degree a reconstitution of technology.[7]

Whereas the effects of prescriptions and margins of appropriation can be observed at the firm level in our empirical studies, the perspective of the social construction and initial inscription of technology remains difficult to investigate in a context where technology might be reshaped but is already pre-scripted in many ways. Without being able to analyse the development or design of a specific technology in our empirical study, we must therefore fall back on an analysis of technology's 'capitalist application', while simultaneously staying attentive to the inherent technical and functional logics, as well as decisions regarding the design of the technology that are empirically accessible to us.

What one can still learn from Marx is that self-perpetuation can neither be equated with tendencies of automation or delegation nor with emergent properties or the opacity of technical processes, but must rather be understood as a social process in which workers are confronted with a man-made – or in Marx's words, their own – product as an alien power of domination. Although technical properties are far from being irrelevant or arbitrary, they only take effect through a certain application. In other words: 'rationalisation and reorganisation processes ultimately always result from the respective linkage of technology and organisation against the background of the respective economic conditions' (Menz, Nies & Sauer, 2019:183).

## Self-perpetuation in digital capitalism

Let us briefly consider what we have learnt so far. We have developed a notion of self-perpetuation that aims not simply at inherent technological dynamics, but at the inversion of (man-made) forces into means of subjugating living labour. In addition to affecting working conditions, this kind of self-perpetuation also comes with an appearance of inevitability – although it is a social product in several respects: in terms of both the application and the development of technologies, as well as the social purposes behind the application. With this notion of self-perpetuation in mind, we will

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7   Therefore, although we particularly focus on obstinate appropriation and reshaping of technology, we do not follow more radical social-materialist constructivist approaches that emphasise the constitution of technology only through *enaction* as 'technology-in practice' (for example, Orlikowski, 2000; more critically, Mutch, 2013).

now turn to digitalisation and demonstrate how this understanding could contribute to the analysis of digital capitalism by clarifying the relationship between domination and technology. Guided by our empirical insights, we critically engage with a current diagnosis: that of digital Taylorism, which seems to represent the most comprehensive variant of digital self-perpetuation as a utopia for capital and a dystopia for workers. We take this diagnosis as our starting point to address alternative modes of real subsumption and self-perpetuating technologies in digitalised capitalism, based on our empirical cases.

## Does (digital) technology turn against management?

Before we discuss the self-perpetuation of digital technology as a process of subjugation of the worker, we first need to address an obvious objection to our understanding of self-perpetuation. One aspect discussed in the current debate on digital technologies and artificial intelligence revolves precisely around the issue that management functions are also becoming increasingly automated and whether and how technology is becoming independent from the intentions of management (Raffetseder et al., 2017; Evans & Kitchin, 2018; Nies, 2021). In other words, it seems as though 'now, technology itself has begun to play the role of management' (Moore, 2018:38). Although we do not object to this analysis, we would like to point out the importance of distinguishing these phenomena from the self-perpetuation that affects the worker. First, it is important to note again that automation and the delegation of tasks to technology do not mean submission to external forces. It would make little sense to speak of self-perpetuation, for example, if the introduced applications function in accordance with the strategies and goals of capital, even though managers cannot intervene in ongoing processes at any given time and even if the mode of operation itself might be a black box for them. The black box character of technology, however, becomes problematic for management when technology does not 'act' according to management objectives – since technology use almost never works flawlessly – and/or because the requirements of valorisation, and hence management objectives, are contradictory in themselves (cf. Nies, 2021). In this sense, technology might be self-perpetuating but does not include the dimension of social dominance. And it is precisely in this respect that there are decisive differences between the dimensions of self-perpetuation. While technical self-perpetuation as conceptualised above is embedded in the social process of control and domination, self-perpetuation in the latter sense primarily appears as unintended effects. Such effects are not a new phenomenon, but they appear to be expanding as a result of the automation of management and control functions. The fact that companies themselves are faced with several dependencies that restrain their decision-making regarding the application of technologies (financial resources, path dependencies and, above all, market forces and the interdependencies of economic networks) does not contradict the fact that managers are nevertheless equipped with very different means of power than workers. This power results from their command over the means of production and puts them in very different positions regarding the application of technologies and their effects. Capitalists govern workers by a principle – the principle of valorisation – by which they themselves are also governed (Marx 1844:11) without relinquishing an economic power that workers do not possess. And this power could

well expand through the digitalisation of management functions. If an 'algorithmic boss' (Moore, 2018:214) really takes hold, it is likely that this will lead to a new quality of technical self-perpetuation that subjugates workers, not management. This is especially so because, through the use of technical systems, issues that were previously understood as interest-driven now appear as a technological necessity. In line with this, Veen et al. (2019) show, using the example of food-delivery services and their use of apps and algorithms, how control technologies are used deliberately in accordance with corporate strategies.

To sum up, we are indeed dealing with an autonomisation of management and, thus, domination functions. However, it seems misleading to use an analogous notion of self-perpetuation to address the functioning of algorithmic management (with all its intended and unintended side-effects) independent of the interference of actual managers on the one hand and the subjection of living labour to a material manifestation of domination by autonomous technology on the other. However, it does make sense to acknowledge that there are systemic contradictions in the managerial application of technology, such as the one between the need for control and substitution and the continuing dependence of capital on the subjectivity and flexibility of human labour. For it is these contradictory aims and strategies that are decisive for understanding the effects of digital technologies on workers and working conditions.

## A digitally renewed Taylorism?

In the debate about the self-perpetuation of digital technologies, one diagnosis has gained particular popularity: the thesis of digital Taylorism or neo-Taylorism (for example Brown et al., 2011; Staab & Nachtwey, 2016; Woodcock, 2017; Gautié et al., 2020).[8] Taken together, the narrative of digital Taylorism states that the use of digital technologies, analogous to traditional Taylorist modes of control, aims at the renewed expropriation of subject-bound (production) knowledge, the expanded fragmentation of work, and permanent control and monitoring. If applied successfully, flexible real-time control in the digitalised company, through data links, the digital connection of all work processes and the use of digital assistance systems, takes away employees' 'freedom of action and devalues workers' qualifications and, not least, their experiential knowledge. In parallel, the automated generation of real-time data and visualised feedback systems are promoting a radical control regime (Staab, 2015; 2020:226 ff.; Staab & Nachtwey, 2016). Furthermore, in the course of digitalisation, knowledge work is also becoming accessible to standardisation and close-meshed control, and even highly qualified employees are potentially replaceable – which, however, creates all kinds of contradictions for companies (see Brown et al., 2011; Huws, 2014; 2019).

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8 To describe corporate attempts at a Taylorisation of call centres, Taylor and Bain (1999) had already coined the term 'assembly line in the head' before the current debate on the digitalisation of work. Overall, debates about call centre work discussed similar phenomena, especially that of an 'electronic panopticon', which are reminiscent of today's debates about digital Taylorism. Empirical research at that time had already shown that the image of total technical control fell short of recognising both resistance on the part of the workers and systemic contradictions and limitations to a mere technical control regime (see Bain & Taylor, 2000; Thompson & van der Broek 2010; Wood, 2018). The debate about 'algorithmic control' on digital platforms is currently taking place using similar premises (see Lee et al., 2015; Rosenblat & Stark, 2016; Gandini, 2019; Wood et al., 2019).

This interpretation follows a tradition of critical Marxist sociology of work which argues that Taylorism is the work-organisational complement to machinery and, therefore, *the* mode that real subsumption adopts (most prominently by Braverman, 1974). Today, it seems, that real subsumption, in the shape of the Taylorist system, has expanded to non-industrial work as well. However, while Marx thought of technology as an immediate, productive force by means of which capital took possession of living labour, for several decades we have been dealing with technologies that serve a different function and do not fall into the category of immediate productive forces. With the advent of information technologies, the term 'organisational technologies' (see for instance Brandt et al., 1978; Sauer et al., 1992) has been used to point out that the focus of technological innovation within a company is no longer on increasing productivity, but rather on the interaction of cost-effective production with simultaneous flexibilisation of operational production and administrative processes (see also Zuboff, 1989). The application of technology as an organisational technology can be interpreted as a reaction to a fundamental problem of the capitalist mode of production beyond the problem of control: the requirement to reconcile the logic of valorisation and the logic of production; the alignment of the economics of the market and the economics of the production process. For the capitalist production process, it has always been a necessity that the technical and organisational structure of the production process, which is directed towards producing concrete use values, must be organised in such a way that it serves the utilisation of capital. However, in times of mass markets for standardised products, this could easily be managed within a Tayloristic rationalisation logic. Since the 1990s, against the backdrop of saturation of the markets and intensified competition, a mediation problem has arisen between market requirements and the logic of the organisation of the concrete production process – a problem that has persisted, if not intensified, up to the present day (Vidal, 2013). Flexibility, readiness and adaptability are central competitive factors, but they have to be reconciled with stable operating processes. Under these circumstances, the object of rationalisation has somewhat turned away from the individual worker towards a 'systemic rationalisation' (Sauer et al.,1992; Altmann & Deiß, 1998) that aims at inter-company and cross-company processes and value chains. This has also been a decisive reason for turning away from Tayloristic control modes: while organisational technologies are intended to optimise processes and make them more flexible, management intends to enable workers to deal with the contradictory requirements of the production process and the valorisation principle autonomously by giving them more leeway in the execution of their work tasks. However, this does not mean that control is abolished; rather that it is being secured through rigid control of performance outcomes (Nies, 2021). Hence, in the face of new valorisation requirements, the flexibility of human labour has gained a central position. While during the industrial age, the mediation between the market and the production process was largely unproblematic, thereafter, it has become the role of the human workforce to deal with the contradictions by reconciling fluctuating demands with the available resources and stable operating processes.

According to the proponents of digital Taylorism, market and production requirements are coupled smoothly and mastered by flexible, adaptive and self-governed technology, that is just by the use of technical means instead of the use and exploitation

of human subjectivity and flexibility. Digitalisation promises to deliver definitive, and purely technological, solutions for managing the contradictory requirements of the market and production. Digital technologies open new possibilities for intervention in markets and inter-company relationships and promise to coordinate production processes precisely with one another and with external requirements, such as market conditions, in a flexible manner. The ideal image would be the autonomous transformation of market requirements into standardised or automated production steps – an integrated system of production and control technologies in which the workers would only have to work through the specified work steps assigned to them (Brown et al., 2011; Staab & Nachtwey, 2016; Gaus et al., 2017). If this scenario were possible, it would mean a comprehensive self-perpetuation of technical systems subsuming workers. It would then no longer be necessary to rely on employees' room for manoeuvre, self-organisation and flexibility, but rigid technical control and determination of work would become possible. The moments of self-organisation that have emerged since the end of Fordism would subsequently prove to be an interlude on the way to an all the more rigid form of control, in which a non-transparent, autonomous system uses workers in ways that depend on the product and market situation, without workers having the means to oversee the processes, let alone intervene in them or determine them. Workers would be locked into a system of technical inevitabilities, which would autonomously and flexibly align with current market requirements.

## Digital self-perpetuation and activisation

Although it is not the only way that digital self-perpetuation can be conceived, the notion of digital Taylorism seems plausible for several reasons. A belief shared by Taylor and his critics was that it is always a risk for capital to leave skills in the hands of workers, because doing so maintains dependence on living labour, including its obstinacy. Accordingly, even if capital has discovered (and exploited) the subjectivity of the worker as a productive force over recent decades, it still seems plausible that if standardisation, dequalification and automatisation prove to be viable and functional paths for capital, they will be adopted unless resistance on the part of workers or functional contradictions set limits to this (Briken et al., 2017). And indeed, it is not only in the popular example of Amazon's logistics centres that we can find tendencies that correspond with Tayloristic principles like the radical separation of manual and mental work, but also in certain types of platform work, for example on Amazon's Mechanical Turk.[9] Consequently, we do not disagree that digital Taylorism is a real

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9    There is an ongoing debate about algorithmic control exercised by platforms, especially regarding microtask crowdwork. The question is, to what extent this can be interpreted as a mode of Tayloristic control. Central aspects that are discussed in this regard are the radical decomposition, standardisation and specification of single work tasks which allow little or no leeway for the worker (Kittur et al., 2013; Howcroft & Bergvall-Kåreborn, 2019) and how the design of the platform renders the capital-worker relationship in a way that precludes individual possibilities of influence and strengthens the invisibility of workers as 'living labour' as they disappear behind web forms (Irani & Silberman, 2013). While platform companies present themselves as 'neutral intermediaries' (Rosenblat & Stark, 2016:3761) that 'nurture autonomous micro-entrepreneurs who can determine the nature of their work independently' (Ivanova et al., 2018:3), this debate shows how they are actually shaping the labour process and subsuming living labour through the design of apps and algorithms – all the more so because this is done in a non-transparent, hardly traceable way.

trend, but we doubt firstly, that it is the only or even most effective mode of utilising and controlling living labour and secondly, that it can be asserted to be a general trend. Furthermore, focusing on principles that are at least similar to those of Taylorism poses the risk of fading out new moments of real subsumption. When we describe these as 'new', we do not mean they were produced by digital technology alone. Rather, we agree with Pfeiffer (2022) that the specific characteristics of digitalised capitalism arise less from digital technology *per se* than from the structural economic problems and crises that are increasingly dealt with digitally. As we want to show below with reference to our own empirical material, the logic of technology use, as well as the logic of self-perpetuation, has changed along with problems of valorisation.

In our current research project, we are investigating – based on case studies and secondary analysis of material from a previous project – the digitalisation strategies of various industrial companies and the effects of these strategies on modes of control in the production sector. For this article, we draw mainly on interviews conducted on three sites of a large automotive and industrial supplier (anonymised as Auto) but also on interviews at a medium-sized company in contract manufacturing in the electrotechnical sector (anonymised as ElectroContract), as well as a medium-sized electronics company (anonymised Electrix) conducted in the course of our previous project (see Nies 2021).[10] In certain departments of the automotive supplier (Auto), we can observe the use of digital technology as an immediate productive force that serves as a means of 'traditional' rationalisation involving the separation of conception and execution and the monopolisation of knowledge. In these departments with low product variety and high production volumes, the work has long been comparatively low-skilled. The machine operators are mainly responsible for loading the machines and have little room to manoeuvre or to engage in a variety of activities. Another striking example of this kind of traditional logic of rationalisation can be found in the toolmaking department of an automotive and industrial supplier, where digital technology is used to deskill operating tasks: Computerised Numerical Control (CNC) machines are digitally linked so that their programs (which change with each order) can be uploaded from a central IT department, thereby restricting the activities of the operators who previously needed to be highly skilled to be able to either create or adapt the programming themselves.

However, most applications of digital technology at Auto as well as in our other cases do not fully fit into this logic of labour rationalisation and are not aimed at deskilling and Taylorisation in the classical sense. Instead, it is striking that in our empirical study – and in accordance with the trend to automatisation of management discussed above – digital technology hardly appears as a production technology, but primarily as an organisational technology. An example of this is the use of digital systems of real-time transparency that we observed in two companies, ElectroContract

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10    So far, the primary survey of the current project involving the investigation of three sites of a large automotive and industrial supplier includes 25 interviews with works councils and production employees. At the time of writing, the surveys in the second major case study within an industrial technology company are starting. Although our insights in that second case inform our line of thinking, the work is too early to be systematically taken into account here. The secondary analysis from the previous project refers to a total of 33 interviews with company management, works councils, executives and production workers.

and Electrix. Such systems have also been introduced in a similar way into every production department at Auto in recent years. In all cases, workers directly receive data on target and actual values at their workstations. At Electrix, additionally, a cross-departmental feedback system in which deviations are communicated to the departments concerned has been established. In the case of the studied companies, the deviation of target times from realistic measurements of work efforts is not the exception but the norm, while in the case of Electrix, target times are explicitly based not on real workloads but on the calculations of the sales department, which passes on the price and deadline pressure to production workers in the form of reduced target times. However, as we will show, these systems and their use do not fit into the model suggested by proponents of the concept of digital Taylorism. Despite heterogenous conditions and market positions between the observed companies, in all cases, the possibility of an autonomous digital coupling of market and production was explicitly negated due to volatile market requirements, complex production processes and small unit numbers.

These systems of real-time transparency all have the potential to enable the direct surveillance of workers. Nevertheless, the use and evaluation of this potential are extremely variable: while direct surveillance is not conducted and is consequently not particularly problematised by Electrix and ElectroContract workers, some workers at Auto told us about superiors who exert personal pressure as soon as the real-time data deviates from the target value. But even in this case, direct surveillance is, despite being technically possible, not the dominant strategy behind the systems of real-time transparency, but rather has the character of occasional authoritarian outbursts deviating from the dominant mode of control by superiors. However, surveillance is not secondary because companies have lost interest in controlling and subsuming living labour, but because the latter is managed differently. Contrary to the diagnosis of digital Taylorism, the integration of the market and production, and the mediation of their contradictions are not accomplished in a purely technical way. Instead, digital technology is used to further activate workers and utilise their flexibility through the confrontation with market-dictated and digitally mediated target times: the digital systems push workers to react quickly to customers' current demands to perform accordingly, and thereby partially hand over the mediation of the requirements of the market and of production to the workers. At Auto, this mode of performance management through real-time transparency is linked to a strategic combination of intensification and self-organisation in the context of the (re-)establishment of group work, including work enhancement. Instead of working on one machine, workers must increasingly work on several machines in autonomous small groups. In our research, we identified two dimensions of this. Firstly, the overall operational process is permanently optimised and time buffers between work steps are minimised as far as possible. Secondly, the transparency of material and operational processes and their disruptions is increased to enable the relevant workers to improve their capacity for self-organisation regarding, for instance, the scheduling of orders, the minimisation of set-up times, the ordering of required material and the handling of malfunctions. Accordingly, at Auto, the shopfloor labour is not deskilled but intensified and made more flexible through a combination of multi-machine operation, self-organisation and

management by objectives, not primarily made possible (as previous examples of group work have shown), but certainly amplified, through the use of digital systems of real-time transparency.[11]

Although these politics of performance often come with partially extended access rights to digital systems and thus delegate responsibilities to the workers, real-time systems and digitally mediated confrontation with market forces contain multiple forms of self-perpetuation. Firstly, the logic of valorisation, which workers (and in a different sense companies) are always already subjected to, is brought more directly to workers to control their performance with parameters whose genesis cannot be reconstructed by them. Therefore, and secondly, in real-time systems, market constraints take on a neutral, objectified and compelling form. The demands come, one could say, neither from the boss nor directly from the market, but seemingly from the digital system itself (Menz & Nies, 2019:176). Thus not only does the interest-political counterpart, but even the market rationale recede more strongly in the consciousness of the employees and behind the technical mediation of performance requirements – 'that come from the system', as a semi-skilled logistic worker in the electronics company told us. Although the demands of the real-time system on workers are a social product in several senses,[12] they nevertheless appear inevitable.

But real-time systems do not only *appear* to be self-perpetuated and beyond the workers' ability to intervene in, but *actually* elude their access at many points due both to their application and their design. First, the real-time systems are accompanied by a formalisation of the labour process, since workers have to confirm the execution of predefined working steps in the digital system – which is also partially the database of the systems of real-time transparency. Therefore, real-time transparency has an effect of process standardisation, even if its logic is primarily result oriented. In this sense, we can observe traces of a new entanglement of market- and result-oriented control and direct control of the labour process – two modes of control that were previously considered to be very distinctive. It is clear that the self-perpetuation of digital systems against workers is quite real, as is evident in a number of areas. These include, not least, the access restrictions, the lack of possibilities to intervene in the definition of working steps or to bypass them when the work situation demands it, the pressure of target values and key indicators, and the non-transparent mechanisms behind the calculation of those indicators. As we have already suggested in concurrence with Marx, this technical subsumption expresses the underlying relations of social domination. The digital system does not serve the interests of self-determined workers but aims at the most productive and temporally flexible utilisation of living labour. Here, too, self-perpetuation of technologies is an expression of the fact that workers are subjected to the decisions of capital according to the existing property relations.[13]

11   Besides the struggle to maintain sites, the increasing burden of intensification is the most important issue for the works council. Almost all shopfloor workers told us that work density and workload have increased significantly over recent years.
12   The process of selection and transformation from the market or customer requirements to the technical parameters confronted by workers is a long one. Of course, the systems do not represent 'the market'; rather, we are dealing with a simulated market that is, nevertheless, related to the actual market situation.
13   Of course, this does not mean that workers cannot resist. But workers' resistance takes place only on the basis of their different position concerning the power of disposition over the means of production.

However, this form of self-perpetuation does not only not contradict the workers' self-organisation, but rather aims directly at activating their performance and flexibility. Consequently, self-perpetuation, as well as formalisation and standardisation are not always rigid opposites to the company's utilisation of a certain, contained form of workers' autonomy and flexibility. In our empirical cases, formalisation and standardisation (of work steps, target values and actual values) thus appear to be preconditions of capital's usage of human flexibility and capacity for self-organisation. In this case, the confrontation of workers with self-perpetuated and seemingly objective parameters proves to be a means of activating employees through the mute compulsion of digital systems and market requirements.

Nevertheless, this simultaneity of activation and containment, and the corresponding use of digital technologies, remains contradictory. The formalised processes, which on the one hand serve the needs of real-time transparency, can, on the other hand, also conflict with the goal of activation insofar as tendencies of formalisation result in a reduction of intervention options for workers. This was also the case at Electrix and ElectroContract. Whereas under the previous system, it was possible for workers to use informal means to prevent malfunctions, this is no longer possible because the system design prevents this. This indicates that the company's aim is not to enable workers to act independently, allowing them a great deal of leeway, but to activate and utilise workers' performance. This also has unintended effects on the companies, whereby technical self-perpetuation can itself become a hindrance. Consequently, self-perpetuation has a contradictory role here. On the one hand, it activates workers, insofar as it confronts them with market pressures that have been transformed into technical variables. At the same time, however, it hinders the informal management of contradictions within the company. It thus enables and hinders at the same time. Given such unintended effects, we see technology use taking on a life of its own against corporate strategies. Formalisation and the lack of possibilities for workers to bypass predefined work steps fit in with the use of digital systems as control and management instruments, but, at the same time, they can have unintended effects that run counter to corporate goals.

## Conclusion: new ways for capital, new elements of real subsumption

In this article, following Marx, we wanted to develop a critical concept of self-perpetuation and use it to look at digitalisation – which, of course, had to involve changes in the concept itself. What changed qualitatively was that digital self-perpetuation does not completely or necessarily follow the same logic as, say, the machine cycle or the Fordist assembly line, both of which, in addition to their disciplinary functions, also followed a logic of increasing productivity (as a means of producing surplus value). Rather, digital self-perpetuation here follows a logic of the market economy – because digital technology in our cases essentially serves to link production to the market and, thereby, responds to the new demands of post-Fordist capitalism. Although many production-related variables are collected and presented by the management through digital technologies, this is not so much in order to do justice

to actual production requirements, but rather to contrast the status quo with target values and market requirements. Therefore, there seem to be two significant changes regarding the forms real subsumption takes today. First, intensification of labour through multi-machine operation, the rationalisation of operational processes, and thus the 'closer filling up of the pores of the working day' (Marx & Engels 1887:278) and the pressure of key indicators gains importance by comparison with the 'traditional' increase in productivity through automation and direct labour rationalisation – phenomena that have gained additional importance since the late 1980s and are further boosted by digitalisation. Second, it is no longer only value production that shapes the 'character of the real labour process itself' (Marx, 2010:426) – which according to Marx is a basic criterion of real subsumption – but also value realisation[14] that exerts a direct impact on the production process and profoundly changes the way of working for workers. As examples of how volatile and diversified market requirements and the corresponding realisation problems have an impact on the work process itself, one can also think of just-in-sequence production (for a management perspective, see Meissner, 2009) or, to use an example from knowledge work, agile management, in which constant engagement with customer demands has become a scheduled and formalised part of labour processes (Daum, 2020; Neumer, 2020).

The key lesson that can be drawn from this is that modes of real subsumption change with the structural transformation of capitalism and its contradictions. Of course, 'classical' moments of real subsumption through production technologies cannot simply vanish: the labour of today's skilled industry worker is no less subjected to real subsumption through technology than the labour of an assembly line worker, but real subsumption expresses itself differently depending on the state of the productive forces and relations (see also Bergmann, 1989:46).[15] However, today, regarding the question of what forms work organisation and the usage of living labour take, additional and more recent aspects are important considerations. Above all, it is important to take into account the digitally mediated (and thus technically legitimised) confrontation of the workers with (technically constructed) market variables and the appearance of objectivity and inevitability that digital systems can give to the valorisation principle and corresponding work requirements.

It is clear that domination has not been diminished, but its mode has changed. Following Mau, we should understand 'the transition from traditional or Fordist to post-modern or post-Fordist forms of management as a change in the form of domination rather than a decrease in the degree of domination' (Mau, 2019:198). In accordance with this, activation of human flexibility and performance as defined above does not mean gentle incentives to improve worker's performance but confrontation with unyielding market constraints, increased formalisation of the labour process through digital specifications and the transfer of market risk to workers, for example,

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14   For a general evaluation of the importance of strategies of value realisation for the digitalisation of the working world see Pfeiffer, 2022.

15   The strong fragmentation of work in classical Taylorism was not only an effect but also a consequence of the low degree of automation at that time (cf. Hartmann, 1985:285). The state of the productive forces at that time did not automatically and without alternative result in Taylorism though. Machinery and Taylorism are not necessary complements.

through the employment relationship as indicated by the increased introduction of temporary work even in the well-unionised industrial company we researched. Living labour here underlies real subsumption through a combination of intensification of work, mostly by multi-machine operation and rationalisation of the 'pores' both of labour and operational processes, and a mode of management by objectives that instrumentalises the autonomy and flexibility of workers, both of which are not necessarily enabled but amplified through a digital system of real-time transparency regarding goals and current system states. Contrary to the vision of digital Taylorism, living labour, therefore, is not universally degraded and replaced but subjected simultaneously to a dual process of activation and containment. This is a combination of strategies that is reminiscent of the notion of 'hybrid control' (Callaghan & Thompson, 2001; Veen et al., 2019:4, 14) and what Gandini calls 'techno-normative forms of control' (2019:1041). However, what the concept of real subsumption helps to capture is that capital strategies do not revolve exclusively around control of living labour. Subsumption deals with the question of how living labour and the labour process are formed so that the process of production can be, at the same time, a process of valorisation. The concept of real subsumption can explain how production requirements and valorisation requirements are mediated, and control is only one, albeit crucial, aspect of this mediation.

Lastly, it is important to note that the concept of real subsumption in our understanding does not imply that there are no possibilities of subversion or practices of subjective appropriation of technologies by workers. The concept of real subsumption is an analytical concept and should not be equated with the empirical processes of technology adoption and use along with the contradictions and resistances accompanying this adoption. In short, in this article, we have focused on the more abstract level of capital's goals and strategies, not because we wanted to deny margins of action and modes of appropriation, but to determine capital's attempts to subsume living labour, which precondition the frame for resistance and subjective appropriation. The modes of real subsumption and, thus, the forms of technical self-perpetuation may therefore change, but what remains the same is the implication inherent in a critical notion of self-perpetuation. Since the concept aims to identify the power that the products of their own labour exercise over the workers, it is inseparable from the idea of appropriation. For Marx, it was always moments and expressions of the historically grown capabilities of humankind that turned against them: science, technology and finally, the productive power of labour itself, which appears as that of capital (cf. Marx &Engels 1887:233). Just as the domination by technology cannot be understood without the 'capitalist application' of technology against the workers, it is inconceivable that this appropriation of the productive forces can be achieved without the struggle for an emancipative, that is, self-determined usage of technology on the part of those who – despite margins and moments of resistance – have so far been targeted to be the objects of its application.

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