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Piazza Martiri della Libertà, 33 – 56127 Pisa, Italy
ph. +39 050 88.33.43
institute.economics@sssup.it

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Control in the era of surveillance capitalism: an empirical investigation of Italian Industry 4.0 factories

Angelo Moro *
Matteo Rinaldini †
Jacopo Staccioli ‡§
Maria Enrica Virgillito ‡§

* Cesaer (INRA) - Université Bourgogne Franche-Comté, Dijon, France
† Dip. di Comunicazione ed Economia, Università degli Studi di Modena e Reggio Emilia, Italy
‡ Department of Economic Policy, Università Cattolica del Sacro Cuore, Milan, Italy
§ Institute of Economics, Scuola Superiore Sant'Anna, Pisa, Italy

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Angelo Moro[*] Matteo Rinaldini[†] Jacopo Staccioli[‡§]
Maria Enrica Virgillito[‡§¶]

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Abstract

We explore the extent to which the current technological trend, dubbed Industry 4.0, might increase forms of control inside organisations, by focussing on pivotal firms in the so-called Italian Motor Valley currently embracing its adoption. We find that Industry 4.0 technologies open up great possibilities for incorporating the three forms of control identified by Orlikowski (1991), i.e. personal, bureaucratic, and social, into technological artefacts, often blending them together. If, on the one hand, this implies a technical and theoretical feasibility of enforcing forms of 'Big Brother' surveillance within the boundaries of organisations, and hereby of the workplace, on the other hand, the actual achievement of these possibilities depends on the organisational environment within which the new technologies are implemented.

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[*]Cesaer (INRA) – Université Bourgogne Franche-Comté, 26, Bd Docteur Petitjean, BP 87999, 21079 Dijon Cedex, France.
[†]Dipartimento di Comunicazione ed Economia, Università degli Studi di Modena e Reggio Emilia, Via Allegri, 9, 42121 Reggio Emilia, Italy.
[‡]Department of Economic Policy, Università Cattolica del Sacro Cuore, Via Ludovico Necchi, 5, 20123 Milano, Italy.
[§]Institute of Economics, Scuola Superiore Sant'Anna, Piazza Martiri della Libertà 33, 56127 Pisa, Italy.
[¶]To whom correspondence should be addressed: ✉ mariaenrica.virgillito<at>unicatt.it

1 Introduction

Control is generally defined as the power of influencing or determining individual behaviour and artefacts' functioning (see e.g. Oxford English Dictionary, 2019). Forms of control within organisations act both as enabling and constraining devices: on the one hand, they facilitate the coordination of individual actions; on the other hand, they restrict the scope and outcomes of the latter (Orlikowski, 1991). Control over the work process is at the core of the capitalist development since its inception. Indeed, the capitalistic division of labour involves the possibility of extracting and codifying knowledge, making explicit and transferable what was previously implicit and tacit. In order to accomplish this, forms of control and regulatory processes within the organisation are clearly necessary for the maintenance and reproduction of the system itself.

Control might be exerted in different forms: it might be personal and/or physical control; it might be indirect virtual control; it might be the result of a series of rules and codes of conduct already shared by individuals, such as bureaucratic or legal control; it might be more subtle and intervenes upon the personal sphere of individuals, modifying each own aspirations, expectations, mental representations and categories. To classify alternative forms of control we need to distinguish among two directions: first of all, the space of control reproduction, say, the family, the party, the school, the jail, the clan, the State, and second the means of control maintenance allowing its execution. Generic spaces of reproduction of control, as listed above, fall back into organizations, being the latter of both legal and not legal types. Means of control range from personal physical surveillance, to impersonal technical monitoring, up to symbolic recognition of the authority.

In the present work, we intend to focus on the manifestation of forms of control in pivotal firms currently embracing a process of technological transformation dubbed Industry 4.0 (hereafter, I4.0). By I4.0 technology we refer to the technological artefacts supporting digitalisation of the work process, interconnection of machines and workers, and collaboration between humans and robots. In this respect, we shall circumscribe the space of control reproduction to the shop floor and we shall focus on means of control maintenance ranging from personal, techno-bureaucratic, and socio-cultural attributes. In so doing, we link our work to the traditional literature on the labour process (Knights and Willmott, 1990) and the capability based theory of the firm (Dosi et al., 2001), focussing on both the role of the internal architecture of the organisation and its hierarchical layers, and the socio-technical approach studying the impact of control, exerted by new technological devices, over the work process.

Our contribution, which largely draws upon Cirillo et al. (2018), presents the empirical results of an approximately one-year long field work activity conducted in the so-called Italian Motor Valley, located in the outskirts of Bologna. The latter is a leading geographical area in terms of adoption and development of frontier technologies in the Italian engineering sector. By adopting the conceptual categories of forms of control proposed by Orlikowski (1991), namely personal, bureaucratic,

and social, our results suggest that the current wave of I4.0 technology is opening up the possibility of increasing the room of control over the work process.

The latter phenomenon can occur thanks to the possibility of gathering a large amount of performance data, traceable to the machine operators themselves. This allows the usage of big-data analytics as a mean of control, not simply over the production process, but over workers themselves, e.g. in terms of individual productivity, opening up the prospect of disciplinary scopes.

If this form of control — the collection and use of big-data aimed at increasing management control over the labour process — seems comparable to the one massively exerted over the social sphere by big-tech companies, dubbed 'surveillance capitalism' (Zuboff, 2015), the possibility that this new regime be implemented directly within the organisation of production should be acknowledged.

The remainder of the article is organised as follows. The next section presents an overview of the general characteristics of surveillance capitalism, while in Section 3 the various forms of control inside the workplace and their manifestation in the I4.0 wave are discussed. Section 4 outlines the methodological details of our field-work, the results of which are presented and discussed in Section 5. Finally, Section 6 concludes the work.

2 Control in the sphere of social reproduction

In 2014 the State Council of China released a document launching a new pilot project, the Social Credit System. The project, whose name simply recalls some form of welfare state intervention, actually represents the first claimed governmental program wherein 'Big Data meets Big Brother'[1], intended to rank individual citizens with respect to their degree of social conformity. By means of a massive collection of individual data, mapping the entire social spheres of people, the program intend to condition the possibility of e.g. getting the desired job, choosing the school for one's children, having freedom of travelling abroad, etc. on the individual degree of trustworthiness. For obvious reasons the ranking algorithm is closed source and proprietary, although five factors are known to be at play: being a good tax-payer, a good borrower (in the sense of meeting deadlines), personal and interpersonal characteristics, and preferences and behaviour. The system provide both rewards (such as free loans) and punishments (such as restricting mobility) and is managed by a credit service company related to Alibaba Group Holding Limited. Clearly, the possibility leveraged by big-data collection and analytics of regulating the entire social sphere of individuals represents the most extreme form of digital control.

On the other side of the world, this possibility is currently massively adopted by high-tech companies. Recently, Zuboff (ibid.) introduced the notion of a new regime of capital organisation, called 'surveillance capitalism'. In this respect, the Chinese 'Big Brother' assumes the form of the American 'Big Other': at core of this new accumulation regime lies the process of data generation/extraction, data

[1] See 'Big data meets Big Brother as China moves to rate its citizens'. *Wired* (online), 21 October 2017. URL: https://www.wired.co.uk/article/chinese-government-social-credit-score-privacy-invasion

analysis, and data selling. The first layer is largely a human-intense activity which ranges from consumer unintended data generation, whenever transactions on individual consumption patterns occur, up to piece-work activity based on click farms or generically crowd-work platforms and micro-work activities (such as Amazon Mechanical Turk) (Casilli, 2017; Huws, 2014). Not only humans, but even machines, and particularly robots, when integrated by means of sensors, become data generators. The latter pattern is particularly relevant for the industrial sector. The notion of extraction is deemed appropriate because in the majority of cases data are simply appropriated, even by means of intrusive and brute-force practices, like data storage or illegal penetration on individual privacy. In this sense, this current phase of capital accumulation appears closer to a rentier-economy rather than to a productive capitalist economy, wherein both producers and consumer/workers enjoy the benefits of the value creation process (see also Dosi and Virgillito, 2019). The second layer consists of massive profiling of consumers/users by means of artificial intelligence, a computationally intensive process mainly relying on supervised (e.g. artificial neural networks) and unsupervised (e.g. text-mining and natural language processing) machine learning techniques. The final layer is data selling: the generated profiles are bundled and sold to other companies who then attempt to manipulate individual behaviour through targeted advertising. All this brings the usual capitalist tendency of creating new consumer needs to a higher, unprecedented level, delivering ads and contents directly to those consumers who are already known to exhibit the highest profit potential.

The Big Other turns out to be even more coercive than the Big Brother: in fact, power becomes so pervasive that a given set of actions is not chosen because of the fear of control, implying self-control or sense of conformity, but is perceived as one's own personal idea, for instance regarding the best restaurant, travel destination, accommodation etc. And this occurs because the algorithm is influencing and predefining the repertoire of not simply admissible, but conceivable actions. Finally, this authority does not rest its own legitimacy on any type of democratic social contract, but rather on the brute force, by means of exclusionary and appropriation practices upon individual rights. In this sense, it turns out to be above the law, if not the law in itself. To give an explanatory idea:

> "[Google] should know what you want and tell it to you before you ask the question." (Varian, 2014, p. 28)

3 Control inside organisations in the era of surveillance capitalism

The use of technological artefacts aimed at empowering the possibility of control is nothing new. A long tradition stemming from the labour process theory studies the interaction between the use of technology and its implementation to strengthen and refine forms of control. Take for example the introduction of so called 'productive tools', namely methods of standardisation and procedures intended at de-

creasing workers' idiosyncratic responses and necessity of relying upon individual skills.

Of particular relevance for our study is Orlikowski (1991), which analyses the various forms of control at play in the workplace on the basis of a classical taxonomy adopted in the organisational literature (and in social science in general): personal control, bureaucratic control, and social control (Child, 2000; Pennings and Woiceshyn, 1989). Personal control represents

> "a dyadic relationship between supervisors and subordinates, having its usual expression in direct supervision where one individual assumes authority over the actions of others and closely monitors that action to ensure compliance with orders." (Orlikowski, 1991, p. 11)

Personal control in organisations, i.e. the direct supervision of workers' performance, usually coexists with two additional indirect and impersonal types of control, defined 'systemic' by Orlikowski (ibid., p. 11): bureaucratic control and social control. The first consists of impersonal rules, procedures, and schemes in order to define standards and requirements

> "for adequate job performance [...] specifying what, when, and how production tasks should be accomplished." (ibid., p. 11)

In this way, performance is evaluated according to specific and measurable criteria, by reinforcing the apparent neutrality of policies, procedures, and rules. Social control consists, instead, of a shared ideology, providing a philosophy of interests and norms from which members can deduce their identity and behaviour. Social control has

> "two manifestations: managers' punctuated efforts to socialise employees collectively into the company's values and beliefs and continuous efforts by employees to enforce these values and beliefs on one another." (Carugati et al., 2018, p. 126)

The latter relies on the idea that social control may assume the form of self-discipline, a kind of horizontal disciplinary force (re)produced through the reciprocal peer scrutiny of workers. Clearly, self-discipline works only in the case employees' behaviour is visible, so that it is possible to express (and receive) social approval or disapproval depending on conformity to shared values and beliefs.

Within this theoretical framework, by looking at the impact of electronic tools in the workplace during the late eighties, Orlikowski (1991) shows how Information and Communication Technology (hereafter, ICT) transmutes both personal and systemic control into new forms. In fact, the use of electronic tools allows the managers to overcome direct (physical) supervision with systemic control: the sheer possibility of being controlled activates forms of self-control in the worker. Control therefore becomes implicit, and moves from direct physical surveillance to the more nuanced notion of monitoring. Additionally, while direct supervision allows quality control, conformity, and compliance to the standards only *after* the

product (either material or immaterial) is completed, electronic control enables the *real-time* tracking of operators and product performance along the whole manufacturing process.

Indeed, the fundamental implication of introducing ICT is the deep embedding of technology-driven production rules into means of production. Technological-originated rules entail a much higher degree of acceptance, adherence, and conformity as opposed to human-originated rules: once embedded in a given technology, knowledge and routines become less questionable and more dogmatic. In this sense, the worker is less prone to raise suggestions, improvements, or complaints about the execution of the various tasks. Moreover, most operators are likely to lack of the specific technical skills required to question the various ICT embeddings.

Given the above discussion on the impact of ICT on organisational practices, our reading of the current technological trend, I4.0, is that it will exacerbate the patterns originated and pinpointed already thirty years ago. In fact, the ultimate goal of introducing I4.0 technology within the production process is to achieve productivity gains. According to a widespread managerial rhetoric, by exploiting the possibilities offered by New Advanced Technologies (NATs), firms have the opportunity of becoming 'agile' and 'smart', reducing waste, encouraging the formation of collaborative working systems, and optimising the inter-organisational relations of the so-called 'industrial ecosystems'. This rhetoric is opposed by a reading that emphasises the risks entailed by the pervasive nature of digitalisation and interconnection processes: strengthening concentration (of decisional power) without centralisation (of production) (Harrison, 1994); reaffirming the process of neo-Taylorisation of work through the introduction of micromanagement practices and new forms of proceduralisation (Alvesson and Sveningsson, 2003; Kärreman et al., 2002) characterised by systems of pervasive surveillance (Thompson, 2003; Zuboff, 2015).

Both perspectives emphasise the role of the awareness of the technological transformations taking place on behalf of those involved. Critical perspectives focus on the relationship between the unawareness of workers invested by the so-called 'Fourth Industrial Revolution' and the poor ability to influence the governance of the transformations underway. In some cases, the condition of poor perception of change is led back, suggesting a certain technological determinism (Grint and Woolgar, 1997), to the 'not very visible' character of NATs, which might determine a poor perception of change in the workplace. In other cases, the workers' awareness gap derives from the domain geometry in which I4.0 technology is located, which might determine a differentiated access to the knowledge of the working process. In both cases, the lack of awareness would generate a condition of 'unaware guinea pigs' (Morozov, 2013) that prevents the regulation and democratisation of the transformation processes linked to the introduction of NATs. In the following, we should present the extent to which alternative forms of control are generated and reverberated inside the organisations under study.

4 Field-work methodology

The case studies considered in this paper, seven in total, started with a series of discussion groups between researchers and union delegates of the underlying firms. The discussion groups had the following objectives: preliminarily exploring the issues under study; reconstructing the layout of the production plant and its workflow; identifying potential interviewees; building the relevant access channels for researchers. Access of researchers to the firm premises had been therefore mediated by trade unions. Nevertheless, the sample of interviewees was designed to include also non-unionised workers and to be balanced with respect to the various departments.

Interviews were conducted within the production plants in areas made available by the company or by union delegates. The interview activity was preceded by a visit to the different areas and departments of the plant; this represented a good opportunity of directly observing the state of technology in place and the organisation of work. In parallel, other interviews were conducted with the management of the companies and other technical figures, the selection of whom varied depending on the specific characteristics of the firm. The interviews also gave us the opportunity of collecting business documents and other publications relevant to the current research.

The collection of this material lasted for about one year and has given rise to a corpus of text on which, starting from the theoretical framework illustrated above, we carried out the analysis through a coding system inspired by the Grounded Theory (Corbin and Strauss, 1990; Glaser and Strauss, 1967). This process entailed a parallel and cross analysis (between the researchers involved) not only of the interviews, but also of the relevant literature and the material collected during the investigation, including secondary data derived from direct observation. The collected material had been in fact read and analysed in different moments of the research process, first independently by each author, then through dedicated comparisons during collective sessions.

In the following section, research findings are presented. The focus is particularly on the analysis of two specific technological artefacts recently introduced and integrated in the production processes of the companies studied, namely the Manufacturing Execution System (hereafter, MES) and digital torque wrenches. These technological artefacts allow for real-time collection of digital data related to various aspects of the work activity. Consistent with the outlined methodology, the interviews, the collection of other informational material, and the process of analysis did not follow a principle of statistical representativeness, but rather of concepts saturation. Our results therefore do not aim at formulating proper causal generalisations.

5 Personal, bureaucratic, and social control by means of Industry 4.0 technology

The foremost manifestation of I4.0 consists in the introduction of the Manufacturing Execution System (MES) in the production process. It consists of a centralised software interconnected with all the computerised equipment along the production line whose main goal is to streamline the production process, by identifying the most vulnerable machines (bottlenecks) and the potential causes of their interruption. The MES is able to detect in real-time the production activities, allowing for timely intervention in case of inefficiencies, as well as the collection of performance data at a high degree of granularity. At the same time it incorporates procedures and provides details to the operators (by means of terminal screens located at the various workstations) about optimal times and manners of executing the relevant tasks. Above all, the MES is able to provide to the operator variations of procedures, again in real time:

> "The MES allows you to plan the production with a lot more precision. And you can make a machine that usually works for two shifts work for three. [...] You choose what to produce and the MES computes how long it takes [...]. [The MES] tells you: today you have loaded 10 codes; you'll finish them in 10 days. The 11th day you are free and you can start uploading new codes [...] so it means that you optimise the distribution and the processing time." (Production planner)

> "In the past we used a different software system that was similar to the MES, but the machines were not interconnected. [...] It was more limited. [...] [The MES] has really improved efficiency; it facilitates us reading data and makes life easier for operators, who stay there, with more cutting-edge tools." (Timekeeper)

All this facilitates workers' interaction with tools and machines, but at the same time establishes impersonal rules and constraints to which workers have to adapt. In general, this is not a break with the past: since the first industrial revolution the use of technology as a systemic form of control represents a distinctive trait of the mechanisation of the work process (Noble, 1986). Moreover, since then, systemic forms of control embedded into machines have never resulted in the total inability of workers of affirming spaces of autonomy in carrying out their job (see e.g. Roy, 1952). We find that also in our case studies the man/digital-machine relationship continues to express a dialectic between autonomy and heteronomy. For example, some operators have reported the ability to slow down machines at their own discretion, even newer ones controlled by the MES, if deemed 'necessary':

> "With the MES, I have to input the reason in case of interruption. If I stop for 5 minutes it's okay; if it takes more it will self-suspend, so I have to justify what I did. Then if someone asks me I tell him why I was doing something else." (Machine operator)

However, the novelty here is (i) the exacerbation of the bureaucratic control embedded in the machines and its capacity of instantaneous reconfiguration on the basis of production requirements; (ii) the MES' capacity of merging forms of bureaucratic control with forms of personal control. Indeed, the process of digitalisation and interconnection of machines permits an electronic personal control through the collection of data in real time, opening up to an increase of remotely non-physical direct supervision of workers' behaviour as well as performance:

> "If I know that I have to produce X pieces the software matters, because I can see in real time if I'm within the expected takt-time or not. [...] The MES gives me the time-cycle and in case of stop the operator must clarify the reason for detention. All machines have computers, since recently. [...] I can see what's happening in real time. I see the mapping of all the machines, those that work, those that stop due to lack of material, absence of the operator, and those under maintenance."
>
> (Timekeeper)

Another relevant technological I4.0 artefact is the adoption of digital torque wrenches along the assembly lines (within all the studied factories). The digitalisation of torque wrenches allows the collection, storage, and analysis of high-precision data about how a specific bolt has been tightened. However, such digitalisation appears to be used instead to stiffen the procedure of the various tasks:

> "We use digital torque wrenches more than anything else. [...] They force you to do certain operations in sequence, because if you modify the sequence, they stop working. [...] There are some stations with all the wrench heads inside and, depending on what you have to do, if you take the wrong head it says 'You're wrong, this is the operation you need to do, not the other one'. [...] It adds a constraint to comply with."
>
> (Assembly line operator)

The operators using the digital torque wrench can see on a screen the data of their work; should the bolt be not correctly tightened, the screen would display a red light indicating that the operation has to be repeated; if the error doesn't get corrected (the bolt is not unscrewed and tightened back again) the light doesn't turn green (the signal indicating that the operation has been carried out correctly) and the computer doesn't unlock the tool to perform the next task, thereby enforcing a rigid sequence along which the operator must perform the various operations. In the operator's description of the work process, the bureaucratic form of control incorporated in the technological artefact is evident:

> "The team leaders see if everything has been done and how. [...] But the constraint is put in place by the system. For example, the system tells you to 'tighten the left head' with a series of black dots that turn green as you tighten the screws with the wrench. [...] If you don't tighten them correctly, it gives you a red light on the monitor: so you have to unscrew it and tighten it back again to get the green light. If

> it stays red, you can't go on to tighten the next screws; or if you forget something, you can't move forward. You can't because the system crashes. [...] So, in addition of checking whether you performed the task correctly [...] the system also blocks you."
>
> (Assembly line operator)

The operators' perception of digital torque wrenches is not entirely negative. The same operator points out that the precision of the indications and the constraints set by the system are successful in reducing errors, and responsibilities thereof. However, the increase in bureaucratic control is also evident when operators highlight the positive features of digital torque wrenches:

> "It tells you that if you don't do it, it's because you made a mistake and it reminds you of it and since then the responsibility is yours, because everything is tracked, it's better than that you report the problem, isn't it? It's clear that they also have side effects: before there was such a system, if you had to tighten to X newtons with a torque of 3 degrees and you did it by hand loosing, say, 4 degrees, nothing happened. Keep in mind that 4 degrees is virtually nothing. Or, if before you were used to tightening one up and the next down, and then do the opposite, now you can't. And if you do it all day long that matters. In this case, the digital system doesn't give you the green light and you have to unscrew and tighten it back to the right point indicated on the monitor. [...] I'm talking about things that last for seconds, because you hold the wrench in your hand, press the button and unscrew, go back, press the button and tighten it back, and you get the green dot, otherwise you can't move on. But if it gives you the green, you are okay, no discussion, the system said it." (Assembly line operator)

Moreover, the data can be processed in real time and monitored remotely from a supervisor, therefore merging, also in this case, personal forms of control with bureaucratic ones. All this recalls a monitoring system similar to the Benthamian 'Panopticon', where the physical architecture is replaced by a virtual one:

> "The wrenches are connected to online computers. [...] When they make the final check on the product, they see if you've done all you were supposed to do. [...] They can see it right away, even from the other side of the plant." (Assembly line operator)

The totality of the collected data can be accessed by supervisors and middle management, but at the same time several screens are positioned along the assembly line, publicly showing some real time data about individual performances, such as errors, stops, delays, timeliness, etc. In this way, operators' activities are always visible to other operators in the same shift: everyone can see and control the performance and behaviour of colleagues. While forms of social control are generally originate from the organisational structure and corporate culture, the 'transparency' provided by these interconnected screens can support the diffusion of mutual surveillance and act as a sort of horizontal discipline device:

> "Each line has a screen showing the production data. [...] Every workstation has a screen where you can see the work you are doing, if there are red lights, the pieces you have made. [...] I can always see it, they are placed there on purpose. [...] But it is right. I can look at it and realise that my colleague has a problem and, in case, I can help him. [...] Previously he had to ask me directly or tell the foreman."
>
> (Assembly line operator)

Although some workers actively undertake forms of mutual surveillance, this is far from being the general case. On the contrary, interviews conducted with supervisors and middle management reveal active efforts of the latter towards socialising operators collectively into the company's values and beliefs (such as productive efficiency) and the persistence of strong (and often justified) mistrust among operators against these forms of control:

> "We are trying to enforce certain rules and simplify operators' work. But the large majority of workers say it's a waste of time. But we are trying to make them understand that it is something the company needs not to lose money. We do not control them and the machine can go even when they are on physiological break. But after the 5 minutes it stops, so the operator will have to put the reason [for the stop]. The driver is to reduce downtime, but in order to monitor them, previously we had to be inside the workshop; now we have a system for each machine and in real time I get a lot of information. Now it's like having a timekeeper for each machine." (Timekeeper)

At the current stage of technological implementation, we were unable to find proper forms of big-data analytics or explicit use of collected data to rank workers' individual productivity, with the aim at punishing or rewarding the outliers. What we have found, however, is that the new technologies, in addition of developing the potential for hierarchical control and reduction of workers autonomy, also tend to increase the time pressure exerted by the labour process upon the latter. In facts, whether it occurred through an increase in production output, production phases, or tasks to be accomplished in a given time frame, or rather through a reduction in non-productive time allowance, most of the interviewees have witnessed a general intensification of working rhythms. We find especially remarkable that some of them seem to identify the roots of such intensification in newly introduced technological implementations. This reveals a certain degree of workers' awareness about these very innovation processes:

> "I have seen an increase in numbers. There is a product which, when I arrived here, I was making 7 pieces [per day]. [...] Now, with the robot, it's 130. I used to make 7 pieces, now I make 130. This is not the case everywhere, but also on the assembly line production rhythms have increased." (Machine operator)

The perception of intensification of working rhythms by operators, found in almost all the case studies, points towards the existence of a pattern of general continuity

between the organisational effects induced by the adoption of I4.0 technology and those entailed with respect to the lean production paradigm. In a way, it is already acknowledged (see Cirillo et al., 2018) that the I4.0 wave is fostering the leanness of the production system and hardly represents a paradigm shift, as the introduction of I4.0 technology is often accompanied by lean management forms.

6 Concluding remarks

In this work we explore the extent to which the current technological trend, dubbed Industry 4.0 (I4.0), might increase forms of control inside organisations. We find that I4.0 technologies open up great possibilities for incorporating the three forms of control identified by Orlikowski (1991), i.e. personal, bureaucratic, and social, into technological artefacts, often blending them together. If, on the one hand, this implies a technical and theoretical feasibility of enforcing forms of 'Big Brother' surveillance within the boundaries of organisations, and hereby of the workplace, on the other hand, the actual achievement of these possibilities clearly depends on the organisational environment within which the new technologies are implemented.

This means that the exact manifestation of control rests upon the 'politics of production' (Burawoy, 1985), and that forms of resistance and conflict can arise from the shop floors. In one of the studied firms, workers immediately spotted the potential threats of I4.0 technology in terms of an increase of individual control; a contractual agreement was signed, ruling out the possibility of using the MES to track individual productivity, or for disciplinary purposes.

In this respect, the presence of unions or other forms of workers' representation is pivotal in shaping future trends. In fact, as stated by part of the literature (see, among others, Rubery and Grimshaw, 2001), the very same technologies can be oriented towards increasing workers' autonomy, making their work meaningful, disseminating information, and developing their awareness. In short, towards humanising and democratising work.

Nonetheless, in our case studies, the organisational solutions that have been implemented (in spite of the presence of strong trade unions) tend rather to accompany the potential of control of these new technologies, to reduce workers' autonomy, and to maintain their awareness of the innovation process at a low level. In this regard, the increased saturation of internal working time, through the reduction of slacks, pauses, and possibility of errors, the latter being an explicit target of the current I4.0 wave, plays a fundamental role.

In conclusion, if it is possible to acknowledge the paradigm shift implied by the use of artificial intelligence and big-data analytics to exercise and reproduce control over the social sphere in general, it is on the contrary impossible to recognise a comparable paradigm-shift when it comes to the implementation of I4.0 technologies within workplaces. The latter, seems rather a general continuation along the trajectory of lean management practices.

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