

CHAPTER 5

Black Box Power: Zones of Uncertainty in Algorithmic Management

Heiner Heiland

Introduction

Algorithms extend the agency and change the processes of social systems. This is particularly evident in the field of work, where algorithms are used to organise and control labour processes. Such algorithmic management is particularly used in platform labour. Here, platforms act as intermediaries, mediating work tasks to mostly self-employed workers, either in the form of local services (such as passenger transport), or globally distributed knowledge work (crowdwork). Such platforms are pioneers and testing grounds for new forms of controlling and coordinating the labour process. Thus, they provide a window into a possible future of work, as there are reasonable expectations that the control practices of algorithmic management embedded in platform labour will spread to other work contexts, even to areas of highly qualified work (e.g. Schweyer 2018; Sánchez-Monedro and Dencik 2019; or the ‘productivity scores’ in Microsoft 365).

Platform labour is a radical form of outsourcing. Workers are not employees of a company, but only have the right to use specific software, access to which can be terminated at any time. They are usually self-employed and pay for their own insurance and equipment, so platform owners have minimal to zero costs.

How to cite this book chapter:

Heiland, H. 2022. Black Box Power: Zones of Uncertainty in Algorithmic Management. In: Armano, E., Briziarelli, M., and Risi, E. (eds.), *Digital Platforms and Algorithmic Subjectivities*. Pp. 75–86. London: University of Westminster Press. DOI: <https://doi.org/10.16997/book54.f>. License: CC-BY-NC-ND 4.0

The workers are thus directly linked to the market and the development of the demand for their labour. Following Karl Weick, such a link between platforms and workers can be identified as a loose coupling, which ‘implies the tying together of subsystems in such a fashion that neither can do without the other but neither has much control over the other’ (Foster 1983, 11). Such loose coupling reduces costs and complexity for platforms, but it also increases complexity elsewhere. Since the workers are not their employees, platforms can only partially instruct them when and how to work. Nevertheless, it is essential for the success of these companies that customer demand is satisfied. Algorithmic management is crucial to meeting this challenge. Despite the formally loose coupling between platforms and self-employed workers, algorithmic management allows for the establishment of tight couplings with regard to the labour process. It allows the platform labour processes to be automated and controlled in detail.

This chapter examines algorithmic management and investigates its mechanisms. It is argued that the existing discussion is partly characterised by technological determinism, which firstly assumes comprehensive control and secondly narrows the view to technological aspects. Drawing on the organisation theory of Michel Crozier and Erhard Friedberg, the limited agency of heteronomous actors is analysed. The focus is on the opacity of algorithmic structures, which contributes decisively to the effectiveness of algorithmic management. This mechanism is identified as *black box power*, leading to an algorithmic self which monitors its actions carefully and is obedient in an anticipatory manner.

Algorithms and Algorithmic Management

Algorithms are not a new phenomenon. The term describes a calculation method by means of which decisions can be made according to a given structure – ‘if A, then B’. This means that even a simple building instruction is an algorithm. As a result of increased computing capacities, the performance of algorithms used has improved significantly over the last few years, and with the ubiquity of computer-supported mediatised environments, so has their relevance. Thus, algorithms have become responsible for the coordination of numerous social activities within a short period of time. The focus within current academic literature is mostly on consumption algorithms that are used in online retail, social media or search engines. Furthermore there are work algorithms that are used ‘to direct workers by *restricting* and *recommending*, evaluate workers by *recording* and *rating*, and discipline workers by *replacing* and *rewarding*’ (Kellogg, Valentine and Christin 2020, 367, emphasis in original). It is not new that the use of technology in the labour process shifts ‘the balance of power between capital and wage labour a significant step further in the direction of a position of extensive powerlessness for wage earners’ (Schmiede

2015, 69). Previously, machines have been introduced by management and they determined specific ways of use, as did assembly lines that determined the direction and speed of the labour process. Although technological artefacts always have an ‘interpretative flexibility’ (Oudshoorn and Pinch 2003, 2), the technological factuality of algorithms is much more pronounced and predetermines a much narrower corridor of action for workers.

A precondition for this is datafication, that is, the standardised capture of social reality in forms that can be processed by computers. This results in a specific reproduction of social relations. Thus, for example, the evaluation systems of platforms represent a datafied objectification which allows for the processing of previously informal and socially interwoven aspects. By means of datafication, complex social relationships and individuals are dematerialised and remodelled as reduced data structures in the form of ‘numerical representations’ (Manovich 2001). Algorithmic calculations result in a rematerialisation that represents the ‘materiality of software’ (Fuller 2008). Thus ‘virtuals that generate a whole variety of actuals’ are created (Lash 2007, 71). This process is not objective. Just as there are no ‘raw’ data (Gitelman 2013), there are no objective algorithms (Beer 2017; Eubanks 2018; Kitchin 2017; O’Neil 2017). Despite this, they appear as objective mechanisms and thus lead to a ‘new empiricism’ (Kitchin 2014). The independence of algorithms from human decisions does not lead to the neutrality of software, but instead to invariance in the given processes. For, ‘code is law’, as Larry Lessig (1999) notes. Programming demands quasi-total conformity from the users and appears as non-negotiable.

In addition, algorithms are ‘enigmatic technologies’ (Pasquale 2015, 1) ‘whose workings are mysterious’ (*ibid.*, 2). Following Burrell (2016), there are three opacities of algorithms. First, they are kept ‘behind veils of trade secrecy’ (Pasquale 2015, 2), because they are a key component of production in competition with rivals. Second, algorithms are not comprehensible for most people due to technical illiteracy, even if their code is transparent. And third, machine learning algorithms continue to develop independently, ‘without regard for human comprehension’ (Burrell 2016, 10). Algorithms are thus a formalisation of social processes whose modes of operation are opaque. As Pasquale (2015, 8) points out, the ‘values and prerogatives that the encoded rules enact are hidden within black boxes’ and ‘authority is increasingly expressed algorithmically’. Moreover, the opacity disguises who is responsible for the decisions. Through such an ‘agency laundering’ (Tsamados et al. 2021, 18–19) companies can ‘hide’ behind algorithms, and opposition becomes more difficult.

In summary, it can be stated that algorithmic management results in a new and comprehensive form of control of the labour process which significantly restricts the autonomous agency of labour. Algorithms provide companies with a ‘secondary agency’ (MacKenzie 2006), so that they can enforce their interests automatically, down to the last detail and in remote locations. However, it cannot necessarily be concluded from the considerable potential of algorithmic management that this can be realised without interruption.

Zones of Uncertainty

As labour processes are usually based on cooperation between workers, they are rarely isolated but located within organisations. Organisations are structured forms of social interaction. Contrary to a one-sided analysis, according to which capital controls labour processes down to the last detail, a micro-political perspective assumes that the valorisation of capital in companies is not simply executable and cannot be enforced without friction. The control and management of work may be planned top-down, but it is not clear whether the workers actually act accordingly in the end. According to Crozier and Friedberg (1993, 18, 39), social action in general and in organisations in particular is always a matter of power. Organisations are shaped by actors' conflicts and are a political and cultural construct (Crozier and Friedberg 1993, 111). Power and resistance are two sides of the same coin. Following Max Weber, power is defined as interaction and social relationship rather than an attribute: 'It is a balance of power from which one can get more out of than the other, but in which one is also never completely at the mercy of the other' (Crozier and Friedberg 1993, 41).

An actor's agency is based on the size of a zone of uncertainty which he 'can control through his behaviour towards his opponents' (Crozier and Friedberg 1993, 41). Control over zones of uncertainty gives actors resources of power. Central to this is therefore the 'manipulation of the predictability' of one's own behaviour and that of others (Crozier and Friedberg 1993, 41). Power belongs to whoever overlooks the actions of others and is at the same time able to make their own actions non-transparent. In organisations, actors interact in games in which they use their power resources and try to influence the rules of the game in their favour.

The management of a company is thus structurally privileged as it can oversee labour process and determine the formal rules of the game. Despite this, workers have at least limited resources of power or control over zones of uncertainty. However, this does not indicate that there is a power symmetry between companies and workers. Instead, there are relative autonomies. Weick (1976, 1) illustrates this by using the metaphor of a football game taking place on a round pitch that is inclined to one side, with several goals and several balls. Depending on the intensity of the inclination, there is a tendency for the goals to be more easily scored by one side against the other. While workers have to expend a lot of energy to win a point, the existing structures support management.

To analyse actors' agency, Crozier and Friedberg (1993, 50) identify four sources of power or types of uncertainty:

- 1) The knowledge of specific expertise;
- 2) a position that provides a privileged contact with the organisation's environment;

- 3) the control of channels in which information and communication are exchanged; and
- 4) the definition and existence of formal rules of the organisation.

These four zones of uncertainty are examined below in regard to algorithmic management.

Algorithmic Management and Zones of Uncertainty

A traditional zone of uncertainty in the labour process and a resource of power for workers is their specific production knowledge. Management coordinates the labour process and is dependent on workers for its realisation. Only workers have detailed knowledge of the various steps in the processes of the work and are therefore in a position to influence, for example, the pace or quality of work (Burawoy 1979). This aspect was central to Taylor's scientific management, which brought to light this zone of uncertainty, so that the labour process could be standardised and organised in a predictable way. One result was the restriction of workers' agency (Braverman 1974). Algorithmic management thus becomes a digital Taylorism. The need to make autonomous decisions is reduced to a minimum for platform workers: either platforms make decisions for them or they are given narrow corridors of action in which to act. Platform-mediated couriers or taxi drivers can choose their own routes, but are monitored via GPS and have to justify themselves in the case of major deviations. Furthermore, on crowdworking platforms, screenshots of workers' screens are taken at irregular intervals (Jarrahi et al. 2020).

The privileged contact workers have within the platforms' environment is also devalued by its algorithmic management establishing a zone of uncertainty. For example, the communication between crowdworkers and their clients is algorithmically monitored, and platforms can recognise, by mention of keywords such as 'PayPal' or 'email', when two parties are attempting to interact outside the platform and thus avoid commission fees (Jarrahi et al. 2020). In locally anchored platform labour (for instance that of food delivery), unobserved contacts with customers do occur, for example during the transporting of people or the cleaning of a flat. However, firstly, these are strongly regulated and mostly only organised by platforms via apps. Secondly, this zone of uncertainty is often devalued by rating systems. Customers are asked to rate workers, and this rating is taken into account, via algorithmic management techniques, in assigning further work. As a consequence, workers, rather than acting autonomously, attempt to second guess algorithmic decisions, undertaking extensive emotional work and anticipatory obedience in order not to jeopardise future work opportunities through triggering automated mediation of jobs by the platform (Chan 2019).

Further, platforms have sole control over the channels through which information and communication are exchanged. They program apps or homepages and therefore determine which information is sent to workers and how. An algorithmic decision cannot be contradicted and platforms tend to react slowly to complaints and requests from workers. For example, a manager of a crowdworking platform says: 'You cannot spend time exchanging e-mail. The time you spent looking at the e-mail costs more than what you paid them. This has to function on autopilot as an algorithmic system ... and integrated with your business processes' (Irani 2015, 229–30). Moreover, interactions between workers are usually limited. While labour processes are typically characterised by cooperation between colleagues, in the case of platform labour this is taken over by algorithms, so that platform workers are isolated. They usually only have alternative and autonomous communication channels such as forums and chatrooms (Heiland 2020, 27–30).

Formal rules can also be used to devalue workers' uncertainty zones. In this respect, Friedberg explains that 'the actual role of the formal structure of an organisation is not to directly determine behaviour, but to structure the scope of behaviour for the actors' (Friedberg 1995, 151). Formal structures are 'the always provisional, precarious and problematic result of a test of power' (Friedberg 1995, 173) as they only achieve their effect when they are respected. Ignoring them or deliberate misinterpretations undermine them. It is also true for algorithmic management that its decisions only work when realised by workers. However, as mentioned above, its decisions are more binding and limit the scope of interpretation much more drastically. You cannot negotiate with code. Algorithmic bureaucracies are far more inflexible and rigid, so that the 'algorithmic cage' (Rahman 2020) they create deprives workers of power resources.

All these aspects occur in different variations and with different emphases in all forms of platform labour. In summary, it can be said that algorithmic management has created a new form of technological control that comprehensively governs the labour process and leaves only little agency to the workers. However, the discourse on algorithmic management tends towards technological determinism. Firstly, it should be noted that talk of an all-encompassing control is premature. A closer look – especially by using ethnographic analysis – shows that even under algorithmic management, workers are able, in limited ways, to act autonomously and resist forms of power (e.g. Heiland and Schaupp 2021). Secondly, although the control regimes in platform labour are technologically mediatised, their mechanisms are not solely technological. For example, platforms create internal markets in which platform workers compete for orders or shifts (Heiland 2019a; 2021a). In addition, and as discussed below, the algorithmic cage is invisible and opaque.

Black Box Power

Algorithms are black boxes. Although they determine the platform workers' daily work routine, the latter have no reliable knowledge about how they work. Platforms thus create a zone of uncertainty that is not comprehensible to the workers and is an important power resource for controlling the labour process, because 'uncertainty from the point of view of the problems is power from the point of view of the actors' (Crozier and Friedberg 1993, 13). Despite this, algorithmic decisions are rarely unexpected or irrational, as their basic objectives are usually obvious. For example, an order should go to the driver who is geographically closest to the customer. Further, platform workers are experienced in working with algorithms. They acquire this experience individually and, additionally, many workers discuss algorithm decisions and logic in lively exchanges in online chatrooms and forums (Heiland 2020, 27–30; Brinkmann and Heiland 2021).

Thus, in working with algorithms, platform workers are engaged in an individual and collective process of making sense in order to reduce uncertainty about opaque labour processes and to make its procedures predictable (e.g. Bishop 2019; Reid-Musson et al. 2020). The workers discursively and mentally reconstruct the algorithms, which allows them to understand the software. They project this ontology onto their reality and actions. A similar phenomenon is seen in computer game players, who develop a mental image of the computer model and adapt their actions to it (McGowan and McCullaugh 1995, 71). However, these reconstructions of algorithms are inevitably fragile. They only approximate actual algorithms and require – especially in the case of machine learning algorithms – constant adaptation. The reliability of expectations which the platform workers try to establish with their interpretations is therefore necessarily limited. In addition, the interpretations are often wrong. Usually, the platforms follow a 'logic of efficiency' (Friedberg 1995) rather than a 'logic of control' (Heiland and Brinkmann 2020, 135). With regard to algorithms, the main priority of platforms is the efficient design of the labour process and disciplining workers is only a secondary concern. Workers, on the other hand, often have a strong distrust of platforms and their intentions (Reid-Musson, MacEachen and Bartel 2020). For example, they wonder how the algorithms decide who gets an order when several drivers are at the same place or several workers have the same rating. They assume that platforms collect comprehensive data on the performance and compliant behaviour of workers and use it in the labour process.

The opacity of algorithms affects not only the labour process, but also the individuals themselves. In a survey, 63% of a sample of German platform-mediated food couriers reported feeling at the mercy of technology very often or often – only 10% stated that they were not aware of this feeling (Heiland 2019b, 302). Algorithmic management increases the platforms' *de facto* control

over the labour process. At the same time, the pressure on workers to control themselves also increases. Instead of being obedient to the algorithmic specifications alone, the usually self-employed platform workers must view themselves as entrepreneurs, responsible for the creation and realisation of their own workload, which they must maximise and optimise out of self-interest. The workers thus not only have an ‘invisible supervisor’ through direct algorithmic control (Elliott and Long 2016, 138), but, due to uncertainty regarding the logic of algorithms, they internalise forms of control, and are self-policing, and this ensures they will conform and strive to continually improve. As known from other forms of work, workers develop an individualised sense of responsibility for their own employment and its continuation (Neff 2012, 28). Platform workers are thus not only subject to direct algorithmic power, but also to indirect and complementary *black box power*.

With the opacity of algorithmic management, platforms create a new zone of uncertainty, which are at their disposal, and at the same time devalues zones of uncertainty on the part of workers. For example, the speed of food couriers is not taken into account by algorithms, meaning that workers can influence the intensity of the labour process by utilising this knowledge. However, because of black box power, there is uncertainty among workers about this fact, and this power resource is therefore little used.

Finally, it should be emphasised that algorithmic management has a comprehensive but not an all-seeing gaze. It does not devalue all zones of insecurity and power resources of workers. Thus, they do have, to a limited extent, autonomous and sometimes resistant agencies (e.g. Heiland 2021b). Further, it is crucial for countering black box power that workers try to reconstruct the logics of algorithms based on their experiences and through communication with colleagues. It is therefore their pre-existing mistrust of precarious working conditions and the poor reputation of the platform that drives them to obedience in the first place. It is still unclear to what extent this form of control is a deliberate strategy of platforms or an unintended consequence. What is certain, however, is that, as a matter of course, they neither explain the basic logic of the algorithms to workers nor clear up obvious misunderstandings.

Conclusion

There is a long tradition of controlling labour processes via technology. Algorithms add a new chapter to this history. By means of these algorithms, control becomes automated, more detailed and applicable to new areas. It devalues zones of insecurity and thus the power resources of workers. At the same time, the analysis of algorithmic management runs the risk of one-sidedly emphasising technology as an explanation for workers’ heteronomy. Next to technological control struggles over transparency and predictability have existed throughout capitalism’s history. For example, in the early phase of industrial capitalism, as

described by E. P. Thompson (1967), capital attempted to conceal the actual time of the day in order to conceal the working time of workers. Accordingly, the opacity of algorithms must be considered a central element:

Uncertainty about the algorithm could lead us to misjudge their power, to overemphasise their importance, to misconceive of the algorithm as a lone detached actor, or to miss how power might actually be deployed through such technologies. (Beer 2017, 3)

Subsequently, the potential for control inherent in algorithmic management does not lie solely in the direct monitoring and steering of the labour process, but also in the opacity of the algorithms' logic – here referred to as *black box power*. Total managerial control of work is impossible and, as the analysis of zones of uncertainty shows, workers retain forms of agency despite extensive digital control. But this is limited by the opacity of the algorithms. To return to Weick's metaphor of the football game, algorithmic management not only makes the playing field even more inclined, but also hides the goals and boundaries of the game. As a result, workers have to apply their agency with uncertainty about its effectiveness. Attempts to make sense of algorithms inevitably remain precarious. Additionally, workers under algorithmic management are potentially, but not necessarily, under constant observation.

This has a direct impact on workers themselves. Their algorithmic self is one that is forced to act proactively with the constant danger of economic as well as algorithmic failure. Workers under algorithms are confronted with a market they must interpret and in which they must perform in order to maximise their profits. With algorithmic management, such neoliberal subjectivity of an entrepreneurial self (Bröckling 2015) extends to the separate steps of the labour process. Workers' individual decisions regarding an algorithm have an immediate impact on their futures – be it regarding their wages, the intensity of their work or other aspects – without them ever being completely sure of an actual causal connection between their actions and algorithmic decisions. This uncertainty, based on the opacity of digital technologies, has 'moved paranoia from the pathological to the logical' (Chun 2006, 1). The result is an algorithmic self which monitors its actions carefully and is obedient in an anticipatory manner, even where there is no direct algorithmic control.

References

- Beer, D. 2017. The Social Power of Algorithms. *Information, Communication & Society*, 20(1), 1–13. <https://doi.org/10.1080/1369118X.2016.1216147>.
- Bishop, S. 2019. Managing Visibility on YouTube Through Algorithmic Gossip. *New Media & Society*, 21(11–12), 2589–2606. <https://doi.org/10.1177/1461444819854731>.

- Braverman, H. 1974. *Labor and Monopoly Capital: The Degradation of Work in the 20th Century*. Monthly Review Press.
- Brinkmann, U. and Heiland, H. 2021. Rationalisierung statt Rationalität – Betriebliche Öffentlichkeiten zwischen Refeudalisierung und Revitalisierung. In M. Seeliger and S. Seignani (Eds.), *Ein neuer Strukturwandel der Öffentlichkeit?* (pp. 115–136). Nomos.
- Bröckling, U. 2015. *The Entrepreneurial Self: Fabricating a New Type of Subject*. Sage.
- Burawoy, M. 1979. *Manufacturing Consent: Changes in the Labor Process Under Monopoly Capitalism*. University of Chicago Press.
- Burrell, J. 2016. How the Machine ‘Thinks’: Understanding Opacity in Machine Learning Algorithms. *Big Data & Society*, 3(1), 1–12. <https://doi.org/10.1177/2053951715622512>.
- Chan, N. K. 2019. The Rating Game: The Discipline of Uber’s User-Generated Ratings. *Surveillance & Society*, 17(1/2), 183–90. <https://doi.org/10.24908/ss.v17i1/2.12911>.
- Chun, W. H. K. 2006. *Control and Freedom: Power and Paranoia in the Age of Fiber Optics*. MIT Press.
- Crozier, M. and Friedberg, F. 1993. *Die Zwänge Kollektiven Handelns: Über Macht Und Organisation*. Hain.
- Elliott, C. S. and Long, G. 2016. Manufacturing Rate Busters: Computer Control and Social Relations in the Labour Process. *Work, Employment and Society*, 30(1), 135–51. <https://doi.org/10.1177/0950017014564601>.
- Eubanks, V. 2018. *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor*. St. Martin’s Press.
- Foster, W. 1983. *Loose-coupling Revisited: A Critical View of Weick’s Contribution to Educational Administration*. Victoria University Press.
- Friedberg, E. 1995. *Ordnung und Macht: Dynamiken organisierten Handelns*. Campus.
- Fuller, M. 2008. *Software Studies: A Lexicon*. MIT Press.
- Gitelman, L. (Ed.), 2013. *Raw Data Is an Oxymoron*. MIT Press.
- Heiland, H. 2019a. Reversed Solutionism: Technological and Organisational Control of Crowdwork. *PACO: Partecipazione & Conflitto*, 12(3), 640–64. <https://doi.org/10.1285/i20356609v12i3p640>.
- Heiland, H. 2019b. Plattformarbeit Im Fokus: Ergebnisse Einer Explorativen Online-Umfrage. *WSI Mitteilungen*, 72(4), 298–304. <https://doi.org/10.5771/0342-300X-2019-4-298>.
- Heiland, H. 2020. *Workers’ Voice in Platform Labour: An Overview*. Hans-Böckler-Foundation.
- Heiland, H. 2021a. Neither Timeless, nor Placeless: Control of Food Delivery Gig Work via Place-based Working Time Regimes. *Human Relations*. <https://doi.org/10.1177/00187267211025283>.

- Heiland, H. 2021b. Controlling Space, Controlling Labour? Contested Space in Food Delivery Work. *New Technology, Work and Employment*, 36(1), 1–16. <https://doi.org/10.1111/ntwe.12183>.
- Heiland, H. and Brinkmann, U. 2020. Liefern Am Limit: Wie Die Plattformökonomie Die Arbeitsbeziehungen Verändert. *Industrielle Beziehungen*, 27(2), 120–40. <https://doi.org/10.3224/indbez.v27i2.02>.
- Heiland, H. and Schaupp, S. 2021. Breaking Digital Atomisation: Resistant Cultures of Solidarity in Platform-Based Courier Work. In P. Moore and J. Woodcock (Eds.), *Artificial Intelligence, Automation and Work: Making It, Faking It, Breaking It* (pp. 138–148). Bristol University Press.
- Irani, L. 2015. Difference and Dependence Among Digital Workers: The Case of Amazon Mechanical Turk. *South Atlantic Quarterly*, 114(1), 225–34. <https://doi.org/10.1215/00382876-2831665>.
- Jarrahi, M. H., Sutherland, W., Nelson, S. B., and Sawyer S. 2020. Platformic Management, Boundary Resources for Gig Work, and Worker Autonomy. *Computer Supported Cooperative Work*, 29(1–2), 153–89. <https://doi.org/10.1007/s10606-019-09368-7>.
- Kellogg, K. C., Valentine, M. A., and Christin, A. 2020. Algorithms at Work: The New Contested Terrain of Control. *Academy of Management Annals*, 14(1), 366–410. <https://doi.org/10.5465/annals.2018.0174>.
- Kitchin, R. 2014. Big Data, New Epistemologies and Paradigm Shifts. *Big Data & Society*, 1(1), 1–12. <https://doi.org/10.1177/2053951714528481>.
- Kitchin, R. 2017. Thinking Critically About and Researching Algorithms. *Information, Communication & Society*, 20(1), 14–29. <https://doi.org/10.1080/1369118X.2016.1154087>.
- Lash, S. 2007. Power After Hegemony. *Theory, Culture & Society*, 24(3), 55–78. <https://doi.org/10.1177/0263276407075956>.
- Lessig, L. 1999. *Code and Other Laws of Cyberspace*. Basic Books.
- MacKenzie, D. 2006. *An Engine, Not a Camera: How Financial Models Shape Markets*. MIT Press.
- Manovich, L. 2001. *The Language of New Media*. MIT Press.
- McGowan, C. and McCullaugh, J. 1995. *Entertainment in the Cyber Zone*. Random House.
- Neff, G. 2012. *Venture Labor: Work and the Burden of Risk in Innovative Industries*. MIT Press.
- O’Neil, C. 2017. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. Broadway Books.
- Oudshoorn, N. and Pinch, T. 2003. Introduction. In N. Oudshoorn and T. Pinch (Eds.), *How Users Matter: The Co-Construction of Users and Technologies* (pp. 1–25). MIT Press.
- Pasquale, F. 2015. *The Black Box Society: The Secret Algorithms That Control Money and Information*. Harvard University Press.

- Rahman, H. A. 2020. Invisible Cages: How Opaque Control Tactics Influence Worker Behavior. *Academy of Management Annual Meeting Proceedings*, 1. Academy of Management. [https://doi.org/10.5465/AMBPP.2020.20920 abstract](https://doi.org/10.5465/AMBPP.2020.20920.abstract).
- Reid-Musson, E., MacEachen, E., and Bartel, E. 2020. 'Don't Take a Pool': Worker Misbehaviour in On-demand Ride-hail Carpooling. *New Technology, Work and Employment*, 35(2), 145–61. <https://doi.org/10.1111/ntwe.12159>.
- Sánchez-Monedro, J. and Dencik, L. 2019. The Datafication of the Workplace. Working Paper, 9 May. Data Justice Lab, Cardiff University. [https://datajusticeproject.net/wp-content/uploads/sites/30/2019/05/Report-The-data fication-of-the-workplace.pdf](https://datajusticeproject.net/wp-content/uploads/sites/30/2019/05/Report-The-data-fication-of-the-workplace.pdf).
- Schmiede, R. 2015. Abstrakte Arbeit Und Automation: Zum Verhältnis Von Industriesoziologie Und Gesellschaftstheorie. In R. Schmiede (Ed.), *Arbeit Im Informatisierten Kapitalismus: Aufsätze 1976–2015* (pp. 49–76). Nomos.
- Schweyer, A. 2018. Predictive Analytics and Artificial Intelligence in People Management. Incentive Research Foundation, 27 August. [https://theirf.org/research/predictive-analytics-and-artificial-intelligence-in-people-manage ment/2527](https://theirf.org/research/predictive-analytics-and-artificial-intelligence-in-people-management/2527).
- Thompson, E. P. 1967. Time, Work-Discipline, and Industrial Capitalism. *Past and Present*, 38(1), 56–97. <https://doi.org/10.1093/past/38.1.56>.
- Tsamados, A., Aggarwal, N., Cows, J., Morley, J., Roberts, H., Taddeo, M., and Floridi, L. 2021. The Ethics of Algorithms: Key Problems and Solutions. *AI & Society*, 37, 215–230. <https://doi.org/10.1007/s00146-021-01154-8>.
- Weick, K. 1976. Educational Organizations as Loosely Coupled Systems. *Administrative Science Quarterly*, 21(1), 1–19. <https://doi.org/10.2307/2391875>.