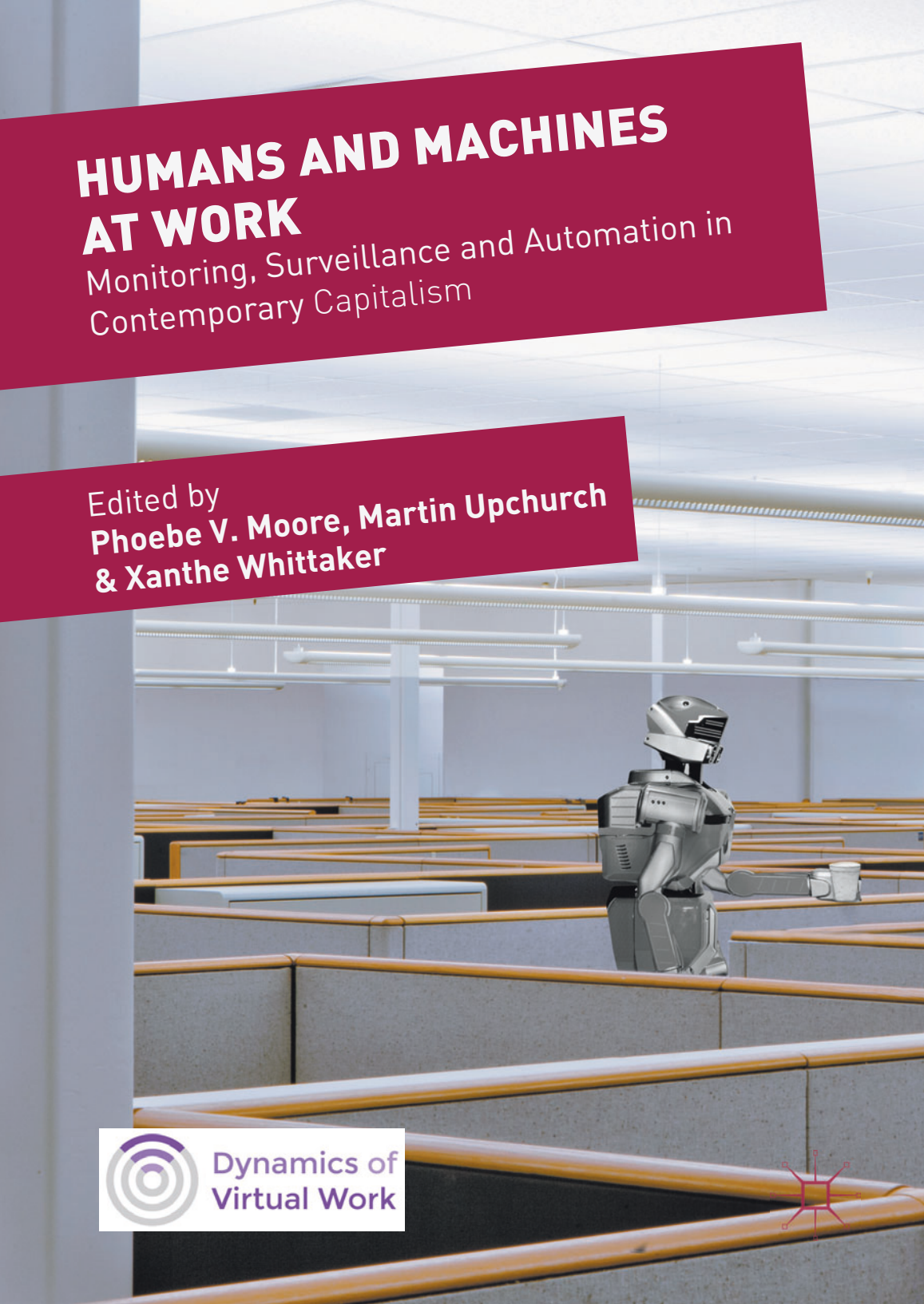
HUMANS AND MACHINES AT WORK

Monitoring, Surveillance and Automation in Contemporary Capitalism

Edited by
Phoebe V. Moore, Martin Upchurch & Xanthe Whittaker



Dynamics of Virtual Work

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Technological change has transformed where people work, when and how. Digitisation of information has altered labour processes out of all recognition whilst telecommunications have enabled jobs to be relocated globally. ICTs have also enabled the creation of entirely new types of 'digital' or 'virtual' labour, both paid and unpaid, shifting the borderline between 'play' and 'work' and creating new types of unpaid labour connected with the consumption and co-creation of goods and services. This affects private life as well as transforming the nature of work and people experience the impacts differently depending on their gender, their age, where they live and what work they do. Aspects of these changes have been studied separately by many different academic experts however up till now a cohesive overarching analytical framework has been lacking. Drawing on a major, high-profile COST Action (European Cooperation in Science and Technology) Dynamics of Virtual Work, this series will bring together leading international experts from a wide range of disciplines including political economy, labour sociology, economic geography, communications studies, technology, gender studies, social psychology, organisation studies, industrial relations and development studies to explore the transformation of work and labour in the Internet Age. The series will allow researchers to speak across disciplinary boundaries, national borders, theoretical and political vocabularies, and different languages to understand and make sense of contemporary transformations in work and social life more broadly. The book series will build on and extend this, offering a new, important and intellectually exciting intervention into debates about work and labour, social theory, digital culture, gender, class, globalisation and economic, social and political change.

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Preface

My first memory of using a computer is one of failure. I was a high school student in Dallas for my final year and a paper I had written on a Dell somehow went missing after the machine had crashed. My memory is sitting in my father's office as he did all sorts of creative manoeuvring to retrieve it. When it came to light, I was of course, very relieved. My main memories are the preliminary anxiety, the period of tense waiting, then the incredible joy. The memory is not of the content of the paper or the class it was for. I don't even recall the PC itself. The memory is related to what I felt was a huge amount of work that had gone into writing the paper and the reliance I had on the machine to produce the work.

My family had moved around the world a lot for my father's job as an anthropologist and it just so happened that we were living in Dallas at the time. Little did I know at the time but these formative experiences would play into my lifelong interests in technology and work.

Some of my memories from that year revolve around the only car Yugoslavia had ever manufactured, aptly named the Yugo. My father had bought more than one: a sort of 'cheaper by the dozen' approach, where if one part on one of these tiny cars, broke, it would be replaceable with a

part from one of the others. *Cheaper by the Dozen* if, of course, the biography of Frank and Lillian Gilbreth published by their children in 1948. The Gilbreths, at the beginning of the twentieth century, led in research on time and motion studies, a technologically driven approach to work intended to make the work efficient and fast.

When the Gilbreths talked about 'cheaper by the dozen', they were of course making a joke about their rather large family, but in terms of time and motion research, *less* is, in fact, more, because efficiency should be improved by using technology to measure and dictate work performed. Scientific management has become a hallmark for thinking about early stages of manufacturing and industrialisation. But as this book shows, the debates about whether scientific management has been fully removed from working practices today, or not, continue to rage. The dangers that the trades unions who stood up to scientific management said in the early part of the twentieth century at the time, were automation, mechanisation and work speed-up. Many of these concerns are becoming ever more possible in the contemporary era as robots replace workers in the factory context and algorithms, cameras and checkpoints begin to replace physical bosses in service work like taxi driving, security and cashier work.

In 2015, nearly a fifth of employees in Europe had access to wearable technology at work. Now, one in three companies provides wearable devices to track activity, save money and allegedly improve employees' health and happiness. What has been called a 'quantified work environment' is one that resembles the world of athletes where technology aids people in identifying peak performance times and gaining rapid feedback. Accelerometers, Bluetooth, triangulation algorithms and infrared sensors allow managers to monitor workers far beyond traditional hours logged by swipecards in the current era. Call centre data reporting has long been used to view workers' emotional responses to customers but the types of monitoring and tracking this book outlines, take things a step further. The Global Corporate Challenge and JawBone Up offer self-tracking packages with dashboards that reveal compared data. A related product, Olivetti Research's Active Badge and its successors Sociometric Badge and Wearable Sensor Badge, can trigger automatic doors, transmit wearer identities and forward telephone calls.

Badges record workers' movements, speech, proximity and interactions, and analyse voice patterns and non-verbal cues to deduce mood and interpersonal influence. These new technologies reflect significant changes in management patterns and workplaces.

I have been working in this area for some years and have always researched the issues workers face in contemporary societies. One cannot discuss work now without considering technology, but I have never seen technology in workplaces as a neutral arbiter. My background in trade union work and international research adds a social justice approach and angle to my work and I was very quick to note the exploitation possibilities for introducing devices into working lives. What were the reasons for introducing new technologies? My research has shown that reasons range from monitoring hours and toilet breaks in factories, to health tracking in offices, to gamification, and even surveillance.

In April 2016, I ran a symposium at the International Labour Process conference in Berlin. I invited several academic colleagues who I knew were researching in the area of digitalised work: Sian Moore, Martin Upchurch, Xanthe Whittaker, Alessandro Gandini and the well-known trade unionist Pav Akhtar who leads the Global Union Federation's managers and professionals unions internationally and predominantly works with ICT workers. Pav has been fighting for workers' rights in digitalisation for years.

The symposium I ran in Berlin was entitled 'New Technologies of Surveillance at Work'. The panel description I had submitted and was accepted to the conference reads:

> A regime of total mobilisation and surveillance corrodes workers' health and safety, creating anxiety, burnout and overwork. Neoliberalism however requires portrayal of such problems as failures to ad- apt, personal psychological shortcomings, or educational deficits. We claim, rather, that surveillance in workplaces are a systematic effect of a particular labour process. Labour movements will need to combat such corrosion or risk the generalisation of the types of psychological collapse seen at the range of suicides recently seen at Foxconn. This symposium looks at a series of cases of surveillance in workplaces as new technologies provide the means to increase, posing the question: what we can do about it?

After a successful symposium, we realised we had enough new material to put together a publication. All speakers from that lovely day in Berlin appear in this edited collection. I am fully committed to supporting women in research projects, and we invited four further authors to contribute, those being Winifred Poster, Yujie (Julie) Chen, Penny Andrews and Rebecca Lemov, who all agreed. In terms of acknowledgements, my co-editors Xanthe Whittaker and Martin Upchurch merit a lot of praise for contributing to this process and never failing to communicate at key points and offering very valued, but under-recognised work that goes into book preparations. I would like to thank my authors for not being late with chapters in most cases and where these were late, they still arrived and were in great shape. We are clearly fighting for the same cause as the level of collegiality in this process has been exquisite. Ursula Huws and Rosalind Gill, editors of this series, and our anonymous reviewers, have been extremely supportive of this publication. Furthermore, Shazad Ali and Tommaso Ramella helped with the final editing processes. I also want to acknowledge my brilliant families, the Moores, the Carters, the van Somerens and my partner Dan for always standing by me. Someday I will probably have to thank robots, but for now, I will leave it there. I hope you enjoy this book.

London, UK Phoebe V. Moore

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Humans and Machines at Work: Monitoring, Surveillance and Automation in Contemporary Capitalism

Phoebe V. Moore, Martin Upchurch and Xanthe Whittaker

Introduction

In the era of the so-called Fourth Industrial Revolution, which is 'characterised by a fusion of technologies that is blurring the line between the physical, digital and biological spheres' (Schwab 2016), we increasingly work with machines in both cognitive and manual workplaces. Technology has had a double-edged identity in workplaces since the well-known industrialists F.W. Taylor and the Gilbreths at the beginning of the 1900s devised schemes to understand workplace productivity by linking it to human behaviour through technologically informed work design.

Indeed, the principle, influence and integration of technology in workplaces can be traced back to the beginning of the industrial epoch,

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where efficiency and productivity gains were prioritised but sometimes with a parallel, albeit often contradictory, desire to uphold the well-being and health of workers akin to the Gilbreths' interest in fatigue and rest which informed the later school of Human Relations and reflected Elton Mayo's research. What is new, now, is the availability and inclusion of a range of unprecedented technologies that can be used to measure, track, analyse and perform work in ways hardly imagined during Taylor's and the Gilbreths' lifetimes. Most importantly for this edited collection, new tracking and monitoring technologies allow management to control work at ever-more intensified levels through the accumulation and use of data about ourselves that was not previously available. Many applications of the new workplace technologies remove management accountability and in some cases, traditional 'management' altogether. This book looks at what this means for workers.

Traditionally, non-routine professional work was delineated into discrete piecework that can now increasingly be performed by machines and artificial intelligence (AI) (Ford 2015; Brynjolfsson and McAfee 2014) in a process extending Braverman's observations in factories and offices ([1974] 1998). More recent researchers note that 'computers, which are meant to help [workers to] do the work more efficiently are also extremely merciless monitoring tools' leading to conditions where, 'work rates are close to the maximum that workers can manage' (Peaucelle 2000, p. 461), leading to high turnover rates and workplace stress. New technologies have also given extra opportunities to form a global division of labour, allowing for outsourcing of routine work and increasing pressures to deregulate labour standards. But workplace technologies of surveillance are apparent in both the global North and global South, from warehouses to art houses (Moore and Robinson 2016).

Innovation in workplace monitoring technologies has adapted older forms such as magnetic pendulums to track and record human steps by introducing new uses for technologies, such as RFID, GPS and cameras. Sensors can recognise faces and detect body odour and fingerprint time clocks are now regularly used for enrolment at work. Algorithmic measures are being used to make human resource decisions and people analytics have advanced so it becomes possible to cross reference with the use of 'dashboards'. So, what was called a 'new surveillance' by Giles

Marx in 1988 takes an even newer form, as intensified methods can be carried out on anyone, anywhere and at any time, for no reason at all. Digitalised surveillance thus introduces a 'step change in power, intensity and scope' (Graham and Wood 2003).

The recent innovation is that deeper and more broadly based forms of monitoring and investigation can be selected and mobilised, based on context, seeing places and spaces, in specific periods of times, creating analogues of digital networks, systems and categories of person (Marx 2002: 10), rather than a more traditional form where specific people whose identities are already known or suspected are rendered suspicious. Previously, we could differentiate between the observer and the observed and technologies facilitated rather than directed processes. Now, predictive policing techniques being developed in the USA and China give the state 'plenty of 'precrime' and 'thoughtcrime' data on its citizens to work with' (Adl 2016). Bizarrely, our perceived knowledge of ourselves could potentially be less than the amount of knowledge, that is, in fact, held about ourselves and that data may even be impossible for us to access. The newest forms of monitoring and observation are increasingly extensive and seen as comprehensive, including both individual and cross-referenced data and information that goes far beyond the traditional records kept by churches or schools that Foucault feared would lead to a 'control society'. Big data about individuals is now generated by algorithmic processes for automated identification and generation of analytics which remove a layer of human involvement, meaning we are undeniably experiencing a new era of technologically enhanced possibilities. As such, as our personal data is increasingly held by the corporate and state machine, we suffer enhanced feelings of powerless and lack of control and an intensified sense of alienation.

This book looks at what happens when a similar level of state-led surveillance and behaviour monitoring enters the workplace. Our primary research question thus revolves around the investigation of what changes is the use of technology bringing to the workplace and what is the impact of technological change on workers? This edited collection looks at a series of cases of surveillance in workplaces and digitalisation and datification of monitoring as new technologies and practices provide the means to increase output and discipline work, posing the questions: what are the

implications of the newest monitoring and surveillance techniques in the workplace? In what ways are they likely to/are they affecting and harming workers and what are the wider implications?

The distinctiveness of this book lies in authors' critical perspectives on new forms of datification and digitalisation of work involving surveillance and performance monitoring, which we link to automation and increasing intervention of machines into workplaces as advances in technologies take unprecedented forms within the rubric of deep automation. Chapters assess the ways in which neoliberalisation of work and workforces involve an ever-intensifying relationship with technologies. Neoliberalisation of the workforce involves technologies of control in the employment relationship. In this edition, we look at where surveillance, new forms of measure of work, and automation are occurring in a range of industries and work forms, asking what the implications and experiences are for workers and what is being done about it, whether by unions or in everyday forms of resistance.

Authors who have looked at surveillance and technological changes in workplaces include Zureik (2003), Ball (2010), Levy (2015), Pasquale (2010, 2015) and Rosenblat et al. (2014). Research on profiling and reputation self-management has become very common in the online labour market as freelancers seek work and as employers or clients actively profile employees with the use of new technologies (Pasquale 2010; Gandini 2016; Bodie et al. 2016). But, what these authors have not captured are the details of the processes of change nor discussed how workers have been impacted by such changes. This book captures the contemporary essence of this process, looking at where it is happening in specific industries and work forms, from media to real estate, domestic care work to Indian call centres, from taxi drivers in China to offices, asking what precisely is happening in these arenas, how people are affected, and what is being done about it. We look at recent trends, identifying how practices that may have been seen as relatively banal and standard in workplace regulation have intensified and become nearly ubiquitous. This collection takes a detailed look at the effect of new data technologies on the surveillance, measurement and management of contemporary work. Most of the chapters offer new empirical

research that engages with existing and emerging fields of social enquiry, in data science, on the quantified self and surveillance.

We present a series of cases of surveillance in workplaces, datification of monitoring, interface management in gig economies and the human costs. New technologies and automation practices provide the means to increase output and discipline work, introducing the questions: In what ways are datafied and digitalised workplaces harming workers? what are the implications of the newest surveillance, monitoring and tracking techniques in the workplace? Even with the extent of data possible, personal privacy is by no means the only contested issue. There are also distinct possibilities for the exacerbation of negative discrimination in the new workplaces which this book outlines.

Technology and Capitalism

To set the stage for this book, we first rehearse the relationship between technology and capitalism. In doing so we must be cautious, for as Govindan Parayil (2002: 39) has intimated in his expansive review of technology 'there is no unified approach to explaining technological change in the historical tradition'. We can discern different approaches in the neoclassical, Schumpeterian, Weberian, and Marxist traditions among others. In neoclassical political economy, Adam Smith recognised the importance of technical innovation as a spur to growth. For him, it was the source of increased productivity by making possible a division of labour. In an early draft of the *Wealth of Nations* (1776), Smith contemplated the introduction of the plough and observed that it was 'probably a farmer who first invented the original, rude form of the plough. The improvements which were afterwards made upon it might be owing sometimes to the ingenuity of the plow wright when that business had become a particular occupation, and sometimes to that of the farmer'. The neoclassicists thus viewed technical innovation as a form of progress which was engendered by capital accumulation. Capital was the input, and technology was the output of economic growth. Increasing capital stock would spur technological innovation incrementally, thus continuing the growth cycle (see both Solow 1956 and Swan 1956).

As such, technical innovation would be a product of necessity, created through the good ideas and technical knowledge of the craft worker or mill owner. In this perspective, advances in technology were engendered exogenously, and there was an assumed neutrality in its effects on the relationship between the workers and the owner of capital. There is an associated school of thought which contextualises the introduction of new technologies as the product of genius, or the inspired acts of individuals who applied themselves to redesigning work. Such individuals, rather than necessarily being central to the labour for which the technology is to be applied, are often inventor–entrepreneurs excited by science, who begin small with their own business, and then become big by exploiting technological advantage (see Hughes 1983, for a detailed historical account). Examples may be Bell and the telephone, the Wright Brothers and the aeroplane, Marconi and the radio. Indeed, as Bob Hughes as explored (2016) in *The Bleeding Edge* the inventions and innovations of individual enthusiasts have more often than not far outweighed those of the corporate sphere, who express more caution and are weighed down with bureaucratic conservatism and 'self' interest.

We see here a potential clash between an evolutionary perspective of technology, which emphasises incremental change linked to industrial progress, and a techno-deterministic approach, which views technology as the primary input to changes in the industrial process, the world of work and society more generally. Such a binary is not always helpful in advancing our understanding. We can also point to important technical innovations and inventions that were the result of a mixture of endogenous and exogenous factors, either created by inventor–entrepreneurs, owner–entrepreneurs or on a collective basis by applied research. We must also recognise that certain technologies have more impact on the world of work than others, sometimes producing a great leap forward in production processes. James Hargreave's spinning jenny, invented in England in 1764, transformed the process of weaving. Steam power allowed railway expansion and the cheaper exploitation of natural resources, and beam engines produced a transformation in textile production. A key example of non-digitised technical innovation in the modern industrial age is the automation of the production line made possible by electronically controlled (rather than manually controlled) machines. We can point to other

technical innovations that spurred processes of urbanisation, such as underground sanitation and water supply. Indeed, the external environment is often the prime motive for spurring new technology, as by-products of a wider goal. War is a time when technology takes a leap forward, as nation states seek to out-gun each other with technical weaponry. Eric Hobsbawm makes such as point in the Age of Extremes (1994: 264–265) whereby the war 'with its demands on high technology, prepared a number of revolutionary processes for later civilian use'.

The transistor (developed in 1947), the first civilian digital computers (1946), as well as nuclear energy were all products which sat alongside radar and the jet engine. Such technologies were part the 'technological earthquake' which heralded the 'Golden Age' of capitalism in the advanced industrial countries and saw the widespread introduction of television, domestic refrigerators, vinyl records (1948) and cassette tapes. During this 'Golden Age' the expansive growth rates in the advanced industrial nations of both the First and Second World appeared inextricably linked to processes of Taylorism, Fordist production methods and automation. Added to this, as the business historian Alfred Chandler (1977) has shown in *The Visible Hand*, was the creation of management and organisational structures that encouraged the exploitation of technology through the advantages of scale and scope. Demand from consumers fed the cycle of automation, most especially for goods in the home. But unpicking the causative relationship between technology, productivity, consumer demand and economic growth is not straightforward. Processes of reverse causation may exist, meaning that economic growth spurred technical development, rather than the other way around. This also applies to digital automation. Neither is it the case that we should necessarily adopt a fatalism about the advance of technology. While it may sometimes seem that technology steams ahead with a life of its own, this appearance can be deceptive. The impact of technologies may only be felt once a critical mass of technology has been accumulated over time (Shih et al. 2008). Finally, there is a 'substantive' perspective adopted by some commentators which views technology as an autonomous agent (Ellul 1964: 14), with the capacity to overtake us in its dynamic (Heidegger 1977: 17). If technology were to be an 'autonomous' agent then surely human agency would be dismissed, rather

than being integral to processes of invention, innovation and application. Thomas Hughes, for example, preferred to use the term 'momentum' to describe spurts of technology 'momentum remains a more useful concept than autonomy…it does not support the erroneous belief in technological determinism … (and) encompasses both structural factors and contingent events' (Hughes 1994: 80).

The integration of societal needs and desires (including war) within the process of invention and technological innovation would indicate that the introduction of new technologies is not simply a product of genius, neither is it a neutral agent of change or an autonomous agent out of human control. The relationship between 'technology' and 'society' is more complex, an insight recognised by many commentators who have rejected both technological determinism and the great inventor and substantive perspectives in favour of a more socio-technical approach (see the edited volume by MacKenzie and Wajcman 1985, for a review). We can point to a 'dialectic of technology', whereby its introduction is contextualised by instrumental factors (Feenberg 1991: 188). Economics will shape technology, or at least the application of technology, in so far that a new product will not be offered to the 'market' if a profit cannot be made. Thus, the conversion from water power to coal and steam power was predicated by the closeness of the mass of workers to coalfields. The geographical location of industry shifted from rural riversides to centres of coal production in Britain in as little as a decade as a result. 'King Coal' forged ahead and fossil fuels (coal, then oil) became the drivers of the economy under new patterns of corporate dominance (Malm 2016). Thomas Hughes used the example of Edison's light bulb, which could only be developed by Edison subject to generating electricity, installing lines and metres, and undercutting the price of gas, as well as making sufficient return on investment (Hughes 1983: 80). His success stands in contrast to the fortunes of the inventions of Edison's contemporary Nikola Tesla, who offered a more expensive alternating current (A/C) alternative to Edison's simpler but less efficient direct current (D/C) system. Tesla's funding was withdrawn when his financial backer, J. P. Morgan stopped supporting him. The social and political framework also helps determine if a specific technology is to be widely reproduced. For example, under the old Soviet system of central planning and

production targets, the key targets to be met were specified outputs within a given time frame. There may have been a disincentive to introduce significant technical advances as this may have upset timescales by the delays caused by retooling and retraining (Kaldor 1981). Only where the system was in direct competition with the west, such as in military technology, were technological advances more keenly initiated by the state. According to Bhaduri (1973) in peasant and semi-feudal societies, where the peasant is tied by debt bondage to the landowner, new technology in agricultural production will be delayed, simply because this would improve the lot of the peasant and lessen dependence on the landowner. In contemporary times, the challenges of climate change mean that political choices need to be made which shape the direction of new scientific research and its practical application, by shifting dependency away from fossil fuels in favour of harnessing renewable energy sources.

We must also question the supposed neutrality of technology. The classical Marxist perspective helps to clarify our understanding on how technology is utilised by capital in the workplace in its own interest. The prime motive is to compete with other capitals by introducing technology to lower unit costs and raise profitability. There is a constant tension between this need to compete and the desire of the capitalist to recoup the investment in new technology. This can only be achieved by increasing rates of exploitation of its workforce or by shedding labour. This process leads to a parallel rise in the organic composition of capital measured by the ratio between constant or fixed capital (itself a product of past or 'dead' labour) and variable capital (capital invested in employing labour-power), which activates the 'living' labour of workers in the production process. The steady rise of the organic composition of capital was considered by Marx as the key factor to explain capitalism's tendency towards crisis. This is because it is living labour, the activity of workers at work, that creates new value. Dead labour, embodied in machinery and previously extracted raw materials, creates no new value. It merely passes on its value in the process of becoming used by living labour. As the ratio changes in favour of fixed capital investment in machines, and capital-bias takes effect, then the relative share of labour in any one production process is reduced, and hence the rate of return on

capital investment (or rate of profit) falls correspondingly. So, while individual capitals are forced to adopt technical innovations to compete, and match or undercut the 'socially necessary labour time' within the product's sector, they are sowing the seeds of stagnation and decline by over-reliance on fixed capital at the expense of variable. Countervailing factors would have to be applied by capital, which would involve getting 'more for less' from individual workers. Instead of being a 'neutral' input, technology becomes instead a means by which to increase the rate of exploitation of those workers left behind in the individual workplace.

Technical innovation is thus laced with the promise of strategies of resistance from workers who may be adversely affected by its introduction. Marx, in considering this tension, related the formation and reformation of human society generally to the '…change and development of the material means of production, of the forces of production…' with the conclusion that 'the mode of production of material life conditions the social, political and intellectual life process in general' (Marx 1859). This is not a technologically deterministic conclusion, but one where Marx uses a dialectical approach, relating technology, and its use, to the social relations observable within a particular society. There is contestation implied between classes and indeed, resistance by the workers in the dying trades and occupations has often defined both industrial relations and the societal conditions of the age. Most importantly, we can observe that the composition of the working population continually shifts and changes with technical innovations. It would be 'vulgar' Marxism to assume that the introduction of a new technology, on the scale of the spinning jenny, the steam engine, or the electric light bulb automatically had the power to reshape society. Mediating factors are needed, which for E.P. Thompson sometimes crystallised around the common feelings of working people of a sense of moral outrage at the way in which ruling elites were abandoning and undermining long held practices and traditions of societal solidarity. In his essay, *The Moral Economy of the Crowds in the Eighteenth Century* (1971) he suggests, for example that the crowds involved in the food riots were 'informed by the belief that they were defending traditional rights or customs, and in general that they were supported by the wider consensus of the community'. The interaction between technology and society was integral to

a wider struggle of how classes saw themselves and acted to shape, or preserve, their world. This book crystallises both the contemporary moment of this process, where technologies sit along a continuum of deep automation and where workers' struggles to counteract the risks of these technologies and to try to preserve the scope to shape our own lives, continue to emerge.

Chapters

The next chapter in this collection lays the groundwork to look at machines and humans at work today, outlining the myriad of technologically developed precision techniques now being rolled out and the emerging power relations with a focus on workers' resistance and trade union responses. New monitoring and tracking technologies resemble mirrors that present specific images of ourselves but once timestamped and stored, uses of such profiles can be manipulated and tailored for better or worse. Surveillance and 'spying' in workplaces are now ubiquitous. The algorithmic boss is also no longer a fiction of science inspired novels. Electronic performance monitoring, people analytics, interface management, mechanisation and big data capture has led to work intensification and stress. Indeed, technology has failed to deliver on its promises to reduce work through automation, but instead creates new avenues for work, for fewer people, who use machines to do work that once others did; and has created a lot of new work for machines themselves observed in factories Moore has visited. Phoebe Moore, Pav Akhtar and Martin Upchurch look at the ways that warehouse, office and gig workers have expressed resistance to these new technological invasions, through documenting interviews with workers in warehouses, offices and involved in gig work. Then we look at the ways in which trades unions, nationally and internationally, are devising strategies and actions in the face of this trend.

The third chapter then focuses on the history of automation. Martin Upchurch and Phoebe Moore look at the relationship between technology, innovation and capital accumulation before focusing on computerisation and digitalisation as a distinct form of innovation. Alongside

digitalisation and advances in interactive web-based communication, we now witness advances in robotics, 3D printing, AI and self-tracking technology, such as Fitbit or smartphone apps that are invading the workplace. In this chapter, debates on technology, old and new, are reviewed, and a Marxist interpretation is presented. Attention is focused on how the concepts of socially necessary labour time and abstract labour may help us understand the real role of ICT at work. We conclude that computers and related technologies are not neutral agents of change but are used by capital as part and parcel of exploitative labour practices and capital accumulation.

Xanthe Whittaker, in her chapter 'There Is Only One Thing in Life Worse Than Being Watched, and that Is not Being Watched: Digital Data Analytics and the Reorganisation of Newspaper Production', looks at digital data as a by-product of digital transformations of production. She argues that the availability of digital data is not only reconfiguring consumer relations, but also has the potential to reconfigure workplace relations, where an increasing array of workers' activities and products leave digital traces that can be monitored. The chapter applies a labour process analysis to a study of a digital newsroom and examines the way in which data have been adopted into the news-making process and how they are shaping it, how journalists have incorporated data into their working practices, how they have resisted them and how data inform editorial decisions. Where data have created new visibilities for the performance of journalists' work it considers the extent to which they also become a tool of managerial control.

Sian Moore and LJB Hayes then discuss the use of electronic monitoring (EM) technology in the highly-gendered labour of homecare work. Their research is based on case studies in two councils in the south west of England where care workers are monitored by the private companies which employ them. Moore and Hayes take particular care to give voice to worker experiences, where EM has been used to delineate workers' time between paid and unpaid activities. The chapter examines the effect this has on both workers' pay and terms of employment in a sector that has been characterised by insecurity, informality and unpaid women's work as well as on workers' autonomy and discretion and the relational aspects of care work.