



Technology and the Labour Process: Insights from Indian E-Commerce Warehouses

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Abstract

In the context of innovation in and the application of information and communication technology (ICT), this article seeks to understand how ICT-enabled tools, including algorithmic processing interfaces, cloud computing software, QR codes and barcodes, have become a new managerial equipment for organising, controlling, and disciplining the labour force in the warehouses of e-commerce enterprises in India. This article engages with labour process theory which accords analytical importance to technology in organising work, for managerial control and disciplinary regimes in furtherance of capital accumulation. The evidence here derives from four month's field work in 2022–23 from Bangalore in south India. Data were generated from 74 semi-structured interviews with employees of, principally, Amazon and Flipkart. The major findings are that an integrated, digitised control system operating in tandem with direct human supervision, ensures the simultaneous processing of products orders and the monitoring of workers' performance. Further, it investigates how they contribute to work intensification and exacerbated job-related insecurities and vulnerabilities. The outcome is extreme work intensity and the creation of new forms of worker insecurity and vulnerability.

Keywords Labour process · E-Commerce · Digitalisation · Technology · India · Warehouse · Amazon

JEL Classification J01 · J53 · L81

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1 Introduction

A salient characteristic of 21st century capitalism is the digitalisation of the economy deriving from rapid and throughgoing developments in information and communication technologies (ICT) (UNCTAD 2017). This widely diffused development, largely unaccompanied or unrestrained by regional, state or transnational regulatory constraint, has had transformative consequences for the political-economic landscape, not least the rise of platform firms (Rahman & Thelen 2019). In the retail sector, traditional retail stores have been supplemented, or even displaced, by online e-commerce. The market share of supermarkets and direct retailers, such as Walmart, Aldi, Co-operative, has reduced, while that of e-retailers, such as Alibaba and Amazon in both the developed and developing countries has grown immensely (Hussain & Vats 2020). E-retailers serve an expanding consumer base by substituting physical with online shopping and connecting consumers with sellers from spatially dispersed locations. Statistical evidence from the USA provides emphatic conformation. E-commerce comprised of 4.1 per cent of all retail sales in the second quarter of 2010, and 10.8 and 16.0 per cent for the same quarters for 2019 and 2024, respectively (US Department of Commerce 2024). Commensurately, the ease of 24/7 shopping and home delivery increased consumption and the frequency of purchase and was accelerated by COVID-19 lockdown's precipitate decline in foot-fall (Kassem 2023). While e-retailers' access to a huge database of consumers, their preferences and purchasing patterns far exceeds traditional retailers' knowledge (Lichtenstein 2009), they additionally offer new services to vendors, selling them spaces on their platforms to advertise products and facilitate transactions. Thus, e-retailers add value to the products by bundling them with the online retail services (Bonacich & Wilson 2008).

The consequences of e-commerce digitalisation are not confined to customers' experiences or vendors' selling practices, but also to the employment relations and the labour process, the mechanisms through which labour power embodied in the labourers is valorised and items are sold to realise profit within the circuits of capital (Newsome 2015). The importance of ICT in extracting and processing information in production and the concomitant labour process has long been acknowledged and theorised (Taylor & Bain 1999; Boreham et al. 2008). Recent developments have cultivated more granular data creating the possibility for micro-monitoring production and service provisions (Staab & Nachtwey 2016; Briken 2020). The e-commerce warehouse work of sorters, pickers, packers, and loaders is organised, monitored, and evaluated through coded algorithms fed into Application Programming Interfaces (APIs), which prescribe specific parameters, including the number of parcels to be processed in given time periods. Digital platforms monitor performance against these pre-determined metrics, contributing to the construction of the mechanisms through which workers are instructed, controlled, and evaluated as orders transition from sellers across and through the warehouses and distribution centres to customers' doorsteps and collection points.

Future of work perspectives have frequently been dominated by the notion of technological determinism (Frey & Osborne 2017), in which technology is accorded

an autonomous status, a self-contained entity which determines societal development (Williams & Edge 1996). Determinism is present in the imprecise designation of technology as a homogeneous group of artefacts, with their distinctive qualities, purposes and impacts eschewed (e.g., robotisation, artificial intelligence [AI], big data, 3D printing, and cloud technology) in preference to a bundling together that portends a pre-determined future. A telling critique of technological determinism highlights its failure to consider the individuality of specific technologies and their effects, its over-generalisation and its lapse into unfounded speculation (Howcroft & Taylor 2022; Levy 2015). An understanding of the digital mechanisms of control in e-commerce warehouses in India—and more generally—requires concrete analysis within the relations of production of the distinctive algorithmically embedded ecosystem, the warehouse management system (WMS), in capturing the progress of orders, the circulation of commodities, and converting this data into machine readable metrics, utilised as parameters for evaluating workers' performance.

Some authors (e.g., Waters & Woodcock 2017) tend to argue that digitally enabled surveillance diminishes the significance of human supervisory control, and in extreme versions of the case, render it obsolete. Haggerty and Ericson (2000) had indicated the presence of human surveillance, but Newlands (2021) contends that algorithmic surveillance remains the predominant mode in contemporary platform capitalism, allowing managers to monitor workers remotely, overcoming the physical boundaries of workspace. Care must be exercised not to fetishise platform-mediated work and to treat its characteristics and labour processes as indistinguishable. Salient differences exist between, notably, gig work of individualised, self-employed app-based food delivery workers or cab drivers, a preoccupation of much academic research (e.g., Woodcock et al. 2019) and those large concentrations of employees in vast warehouses or fulfilment centres. A cluster of meaningful studies have emerged focusing specifically on work and the labour process of the latter (Briken & Taylor 2018; Delfanti 2021; Kassem 2023; Massimo 2020; Struna & Reece 2020) for the Global North, and more recently on 'the less examined terrain of e-commerce workers in the Global South' (Atzeni 2023:182). Nathan and Ahmed (2018) highlight the parallel creation of platform works in India, calling for careful investigation of the nature of work under contemporary platform capitalism.

This article contributes to developing these conceptualisations from empirical data deriving from a study of e-commerce warehousing in Bangalore, India, which evidences the control mechanisms by which workers are subsumed into digital capital. If digital technologies reconfigure the labour process, they simultaneously transform workers' conditions and experiences of work. The first objective is to investigate how digitalised tools, including APIs, cloud computing software, QR codes and Barcodes, have become mechanisms for organising, controlling, and disciplining the warehouse workforce. The second objective is to understand the ways in which these control mechanisms, imbricated by ICT, might contribute to work intensity and worker insecurities. The article concludes with critical engagement between this Indian study's findings on work organisation and the labour process in e-commerce warehouses and the principal themes identified in extant studies from the Global North and the more limited work from the Global South.

2 Labour Process, Technology and Working Conditions

An understanding of the ways in which digitalisation structures and shapes the labour process in e-commerce warehouses in India, may engage with two strands of literature. The first is the labour process theory (LPT), in which technology is regarded as a means of control and surveillance (MacKenzie & Wajeman 1999), that is developed and deployed in furtherance of capital accumulation (Thompson 1990; Hall 2010). The second is to investigate capital's power over labour from the latter's perspective and how technology shapes workers' lived experience (Tronti 2010). Both these theoretical frames privilege capital's control over labour at the point of production, seeking to analyse the mechanisms of control and the extraction of surplus labour through the labour process.

What has been termed 'core' LPT (Thompson & Vincent 2010) begins from acknowledging labour as a commodity and the labour process as enabling 'the conversion of labour power (the potential for work) into labour (actual work effort) under conditions which permit capital accumulation' (Littler 1990: 48). Edwards (1992) emphasises the structural antagonism in the relationship between capital and labour which generates labour indeterminacy, which cannot be resolved through market mechanism, but requires managerial intervention to control and coordinate labour for the purpose of surplus accumulation. Further, driven by competitive pressure, capital needs to continuously transform the production process. Management exercise autonomy in the utilisation of labour power and the configuration of the labour process, which compels it to both exercise control over of and seek cooperation from labour. Thus, the labour process needs to be accommodative of, and adaptive to, workers' responses including resistance (Edwards 1990). Driven by the ineluctable requirement to overcome labour indeterminacy, management orchestrates an ensemble of controls, in which technology is utilised for enhancing productivity, and exercising control over labour.

With innovation in, and the widespread application of digitalisation, control mechanisms have taken new forms. Recent scholarship on the platform economy and gig working has stressed the overarching role of algorithmic labour control (Wood et al. 2019). Such conceptualisation is arguably consistent with the LPT (Gandini 2019), where labour control remains the core of analysis. The LPT has consistently emphasised the labour process as essential arena of contention between labour and capital (Thompson 1990; Burawoy 1979; Braverman 1974) and accordingly provides the theoretical lens through which to analyse this study's empirical data on the labour process in Indian e-commerce warehouses.

Building on Marxist labour theory of value recent work of Cini (2023) has highlighted the centrality of algorithms in transforming absolute surplus value generation in the platform economy. Further, Cardenas-Grcia et al. (2017) argue that digital capital is a digitised 'live' storage of the labour power; a 'virtual live labour' which is sold, rented, and kept for future use by its owner. Thus, digital capital's exclusive capacity to store and process massive amount of data enables enterprises to simultaneously generate immediate surplus and create capital for

generating potential future surplus. Briken (2020) argues that digital capital can not only capture the tacit knowledge of stakeholders, but also the situated knowledge embodied in their cognitive and behavioural information. Notwithstanding their importance, these studies do not consider the point of production (or distribution) at workplace level and how workers, as active agents of production, engage in the digitalised labour process.

Labour process-oriented research on e-commerce warehouses has emphasised the embeddedness of technology and algorithmic control operating alongside and within management hierarchies and supervisory practices (Struna 2015; Struna & Reese 2020). Alimahomed-Wilson (2020) and Delfanti (2021) researched the conditions of workers in the warehouses and logistics chains of Amazon particularly, who are subjected to the intense demands mediated by a digital architecture and driven by the imperative to dispatch orders within the tightest time frames. Others provide compelling evidence of degraded working conditions, precarious and informal contracts, poor pay inadequate benefits and the absence of employee representation and voice in platform work which generate multiple grievances (Berg et al. 2018; Fredman et al. 2020; Gutelius 2015; Newsome 2015; Kassem 2023).

Mindful of the critical thrust of these studies, this article draws on extensive primary data to make a systematic attempt to analyse management control, the labour process, and the experience of work in e-commerce warehousing in India. Studies of work and employment in e-commerce, logistics and warehousing, and specifically Amazon (Gutelius 2015; Briken & Taylor 2018; Delfanti 2021; Massimo 2020; Struna & Reese 2020), now extend beyond those in the developed economies. As Amazon's model became dispersed globally in the COVID-19 context of surging online demand (Kassem 2023), scholars paid attention to 'the less examined terrain of e-commerce workers in the Global South' (Atzeni 2023:182), including this author's important case of South America's dominant e-commerce platform Mercado Libre in Argentina and South Africa's leading enterprise Takealot (Atzeni & Kenny 2021). The principal objectives of this article, to re-iterate, are to investigate how the digitalised, platform-based architecture has become central to organising, coordinating, controlling and disciplining the warehouse labour force in India, and to understand how these ICT-imbricated control mechanisms contribute to work intensity and create insecurities 'associates' might experience. Situating this article within the literature from both the global north and south, it identifies comparable and contrasting characteristics within the hegemonic exercise of what Massimo (2020: 133) terms 'algorithmic bureaucracy'.

3 Data Collection Method and Respondent Profiles

The Indian e-commerce and logistics sector is a recent development, with the entry of Amazon and Walmart in 2011 (Saraswathy 2019). By 2018, the online retail market had reached \$19.5 billion gross value in transactions and had 80–100 million shoppers with a projected annual growth rate of 36 per cent (KPMG 2018). Total employment was estimated at 23,500 in 2012, although exact figures for e-commerce and Amazon during the following period of sustained growth are difficult to

ascertain. However, Amazon and Flipkart created 0.14 million contractual jobs in 2020 alone (Ministry of External Affairs 2021). State support for this sector and its job creation potential prompted the government to establish ‘The Integrated Development of Logistics Sector’ wing of the Department of Commerce and Industry (DPIIT 2022).

Primary data derive from four months of continuous fieldwork (October 2022 to January 2023) in Bangalore, principally the ‘Soukya Logistic Hub’ (Fig. 1) in the Hoskote Taluk of the Bangalore Rural district. This hub hosts more than 50 warehouses, including Amazon, Flipkart, Myntra, E-Kart and Delhivery, alongside logistics companies Mahindra Logistic and Aditya Birla Fashion and Retail Logistics. Semi-structured interviews were conducted with 74 employees from, principally Amazon, Myntra, Flipkart and E-Kart. Purposive sampling delivered respondents from all the diverse warehousing roles. Brief interviews of 5 to 10 minutes were conducted with 36 warehouse workers when exiting and entering the warehouses during shift changes. From probing interviews with local shop owners and waiting truck drivers, workers’ surrounding residential clusters were identified. Subsequently, 38 interviews, lasting 30 min to 2 hours, were undertaken with workers when visiting local shops or sitting outside their houses. All interviews were recorded, translated and transcribed for analysis and each interviewee provided consent. Respondents’ names are anonymised, and the data stored securely, accessible only by the authors. The interview schedule comprised five sections: employees’ roles and responsibilities; the warehouse division of labour, work routines and performance management; work experiences; perceptions of working with technology; contractual terms, hours of work and remuneration. Transcripts were coded for analytical purposes according to appropriate themes, including technology and algorithm driven control. Interview evidence was complemented with data from six weeks of participant observation by one author as a picker in an Amazon’s fulfilment centre. The empirical heart of this article, the evidence presented in Sect. 4 and 5, derives from these qualitative sources. While largely a condensation of and generalisations from the principal themes that are germane to work routines, management control, particularly digitalised, and their effects, judicious, representative quotes from workers illuminate key issues.

The demographic profile (Table 1 in appendix) shows only 5 respondents aged over 30 years, and educationally, 54 respondents were below 12th and 31 below 10th standard. A major caveat of this field work is that all respondents were male because the researcher’s gender hindered access to women. The job profile (Table 2 in appendix) reveals 60 respondents employed in warehouses, either owned by, or operated on behalf of e-commerce enterprises. The remainder were employed by logistics providers. Core warehouse roles of picking, packing, stowing, bagging, loading, and unloading comprised 64 respondents, the remainder engaged in ancillary activities, including truck driving, quality control, security, and safety. Since core roles are not necessarily fixed as some employees are moved between activities, the designated roles reflect their primary reported activity. Fifty-nine were employed by a third party and contractually tied to a recruitment agency or manpower company.

Closely related to the contract type is its duration. All enterprises which recruit through third parties first provide contracts for one month only. Then, depending on

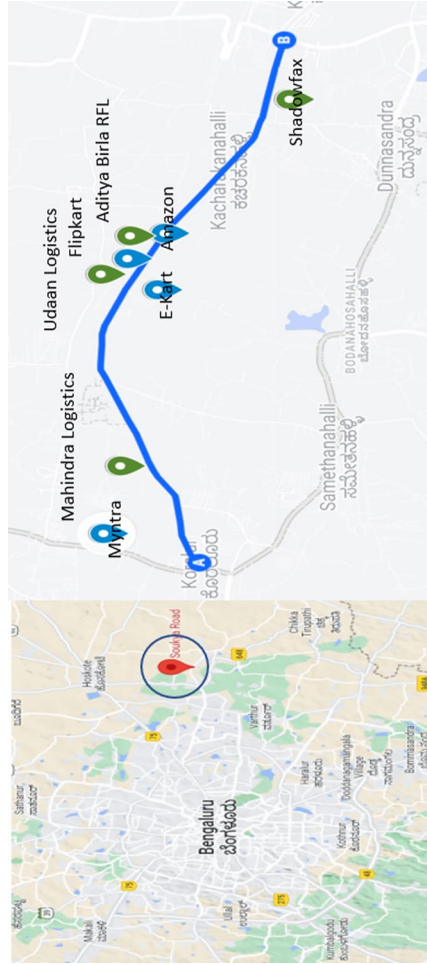


Fig. 1 Soukya Logistic Hub in Hoskote Taluk, Bangalore Rural district. *Note:* Green markers are traditional retail logistic warehouses. Blue markers are E-commerce operated warehouses. Blue line is the 6-km-long Soukya road. *Source:* Google Maps

an employee's performance, contracts are either extended or terminated. Extensions vary between companies; Amazon for one, three or eleven months, while Flipkart does for one, six or nine months. Almost three-quarters of respondents, had less than a year's continuous tenure, and almost two-thirds less than six months. Excepting drivers, transporters, safety, security, and quality check employees, all respondents were on one-month contracts when interviewed. Consequently, among those reporting being employed for one year, many had received at least eleven consecutive one-month extensions. Thus, a year's tenure does not reflect relief from ever-present job insecurity.

Finally, the pay structures were, according to testimony, despite complexity, remarkably similar. In addition to basic salary, bonuses are given. Night shift allowance is awarded for both regular and overtime working. Combining the different allowances and bonuses, average earnings are calculated from the respondents' reports. Sixty-four earned less than ₹20,000 monthly and more than half less than ₹15,000.

4 Technology and the Labour Process

It is essential to grasp the functional divisions of labour to understand the nature and consequences of digitalisation for simultaneously processing items throughout the warehouse and controlling labour. A schematic diagram (Fig. 2) represents the interconnected, but discrete, operations as orders are received from vendors, processed, and then dispatched, although the final stages of customer delivery ordinarily include intermediation of sortation centres and/or delivery stations. When shipments enter the warehouse, they are relabelled to integrate them into the warehouse management system (WMS). This *receiving* stage can be regarded as a primary function of warehousing and logistics. All shipments have barcodes, either UPC (Universal Product Code), EAN (European Access Number) or ISBN (International Standard Book Number). The details of each item, comprising brand, weight, dimension, flavour, colour, and other characteristics,

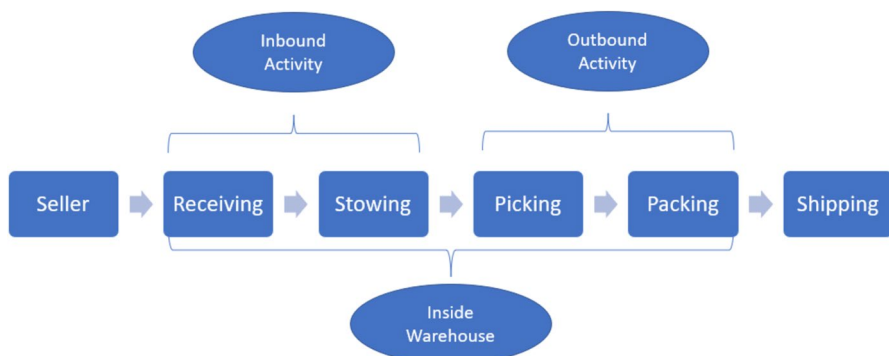


Fig. 2 Processing of the product inside a warehouse. *Source:* Author's creation from field notes and participant observation

alongside sellers' details, are uploaded onto the WMS, by scanning barcodes with handheld scanners. Uploaded data are configured into a new label, a unique barcode with alphanumeric code called a stock keeping unit (SKU), which is printed and pasted on all items.

Items are then stacked into carts parked in staging areas. Both the carts and staging areas have distinct barcodes or QR codes. Workers take carts, scan the area's QR code, and then the cart's barcode. Scanning embeds the cart to the worker's ID logged-in scanner and this information is updated on the WMS. Next, carts are pushed to bins or racks where the items are placed, a stage termed *stowing*. Additional obligatory scanning updates the WMS with the precise bin location. Here the worker first scans the bin, then the item, place it in the bin and rescans the bin. Thus, the stowing and the in-bound process is concluded.

Stowing is followed by *picking*, the first outbound operation, in which pickers take customers' ordered items from bins and place them in totes. They then drop the totes on conveyor belts which transfer them to the next stage in the flow of items. The activity is more challenging than its simple description suggests. A picker first logs their ID onto a handheld scanner, just like the stower. A 'picklist' is assigned to the scanner. Then, pickers scan an empty tote to deposit these items. The scanner displays the picklist and their respective bin locations. The picker runs to the designated bin, scans its barcode, picks the item, scans its SKU label, places it in the tote, and then scans the tote's QR code. The scanner then acknowledges the item as 'picked'.

The next outbound activity is *packing* at designated stations adjacent to conveyor belts carrying the pickers' completed totes. The station has a desk with a monitor, label printer, tape, and airbag machines, and cardboard boxes of different size for packing. First, the packer picks the tote from the conveyor and scans it, the monitor displaying the details of all contained items. Then, the packer takes one item and scans its SKU. The monitor displays the item's details and recommends the appropriate box type for packing. The box is scanned, and the WMS updated. When packing boxes, gaps inside are filled with airbags, the lid closed, and the mouth sealed with tape. The airbag and the tape automatically emerge from their respective machines once the box is scanned. Concurrently, a barcode label, containing the order's and customer's details is affixed. Then, the package is placed on conveyor belts and carried to the final warehouse activity, loading trucks for dispatch.

One observation is that all operations require some combination of digital and human interactions. Indeed, all activities necessitate the utilisation of a scanner to continuously update the WMS about each step in the flow of items through the warehouse and beyond. Workers at each stage of these sequenced tasks are the pivotal agents in scanning and processing orders. Whatever the specific permutations of technological and human intervention in performing the respective tasks, the common characteristic is that digital technology not only tracks items' progress, but also monitors the quantity and accuracy of workers' performance. In sum, the technology that executes the functions according to prescribed divisions of labour, serves the simultaneous purpose of digitalised worker supervision.

Workers throughout the warehouses are obliged to meet certain criteria which, as described by an Amazon human resource (HR) manager during participant observation, are:

“Determined by [first]; not committing any error, [second]; meeting the productivity rate, and [third]; good behaviour”.

If these metrics are not adhered to workers are deemed as underperforming and risk losing their jobs. Management knows whether workers are failing to meet targets because the digital architecture of the WMS provides performance data in real time. It is instructive to consider in detail these three criteria.

1. Not committing errors. An error is the incorrect scanning of barcodes or QR codes. For instance, after scanning a bin, if a picker selects an item other than that displayed and scans it an error is flagged. Another picking error occurs when a correct item is picked but an incorrect label is scanned. Ordinarily, all items have multiple scannable barcodes. To avoid confusion, pickers are instructed to scan the label displayed on the scanner’s screen. However, the required label and code are often missing. While all items have product labels provided by vendors (UPC/EAN), they might not have the warehouse’s SKU labels, an oversight originating at receiving. Additionally, the WMS is immune to errors committed by workers. When a picker scans a wrong item, the scanner instructs them to return the item to the bin, re-scan the bin and select the correct item. Even if the correct item is picked but the wrong barcode scanned, the picker must re-scan the bin, then scan the item’s correct barcode. So, the WMS through the scanner identifies the error and makes the worker rectify it. Ironically, the system’s immunity to error does not protect the workers, rather the opposite. The WMS is programmed to monitor the workers errors and provide management with data on their performance. The consequence of error, as the testimonies reveal, is the issuing of feedback forms, which may accumulate to warning letters. Several warning letters leads to immediate termination. A picker explained:

“If you run behind target, you will create more error, there is a threat to your job, if you make errors. You will get warning letters. Final warning letter is the third one.”

2. Meeting the productivity rate: All functions are subject to the strictest time targets. Almost all workers are compelled to process preassigned numbers of items per hour, the most important metric used to evaluate individual performance. Specific metric may vary between or even within tasks, depending on an item’s category. For instance, in Amazon small item pickers must pick 120 items per hour and packers complete 160 items per hour. Once prescribed numbers are reached workers are deemed to have ‘met the rates’, a prerequisite for keeping their job. If workers continually miss their rates, they are issued with feedback forms or warning letters. One picker articulated this fear-inducing compulsion:

“Once you get feedback, you will feel scared of losing job, that itself will trigger you to run faster. You will run like dogs to meet the rates. When you see the first feedback in your hand, you will feel like if they remove me, how long will I have to wait outside before getting a job. Everybody is working with this fear here”.

Significantly, ‘rate’ numbers, a key element of an organisation’s worker control and disciplinary strategy, are not autogenerated by WMS programming, but determined annually by senior management at board meetings. However, the WMS is fed with these ‘rates’ as productivity parameters and captures extensive data on workers’ productivity, including: the numbers of items processed hourly, totals per shift, active and inactive time, and average time to process tasks at each respective role. Set against the prescribed ‘rates’, data for each individual’s performance is compared and a productivity ‘index’ for each worker on each shift is compiled. These indicators are retrieved by the WMS when workers log-in on entering or exiting the warehouse and logging onto their scanners to perform tasks. Hence, the very mechanism by which workers register their attendance and undertake their tasks is concurrently employed to capture their performance and generate productivity metrics. Through the WMS managers access the performance data of each worker. Moreover, individual’s productivity scores undergo forced distribution, by which workers are ranked statistically against each other, with those lowest ranked becoming the subject of close management scrutiny and discipline. Hence, supervisory agency draws on digitally generated data to evaluate worker performance with a focus on disciplinary action against those deemed by the metrics, as underperforming.

3. Good Behaviour: Prima facie what constitutes ‘good’ behaviours might suggest subjective supervisory evaluation, but it is important to emphasise that judgements are rooted in performance metrics. Thus, notions of avoiding ‘idle time’, ensuring ‘fast start’ and ‘strong finish’ are propagated as examples of ‘good’ or ideal behaviour.¹ Workers are instructed to complete processing at least one item within the first five minutes at shift commencement (Fast Start). Similarly, within two minutes before the shift end, workers must process an item (Strong Finish). To capture those workers failing to achieve good behaviour standards, the company depends on the entry of live time information for each worker’s ID on the WMS. In every process, intervals between two consecutive scanning, say for a picker between scanning a bin and item, is deemed ‘idle time’. If workers accumulate excessive ‘idle time’ or miss ‘fast start’ or ‘strong finish’, they might receive feedback forms or even warning letters. ‘Idle time’ monitoring reveals the scanner to be a critical supervisory device, incorporating data to measure performance, with corrective or disciplinary sanction for workers deemed to be underperforming against the specified metrics.

5 Vulnerabilities and Insecurities in the Warehouse

Evidence suggests that a certain acceptance of errors is exercised during peak seasons, such as the Great Indian Festival or Big Billion Day, when three mistakes might be permissible, because of the potential cost of losing workers. Conversely, during less intense periods, when management retrench their workforce, these brief instances of leniency dissipate, harsh norms are re-established and only three errors are allowed. Such occurrences resonate with Struna and Reeses’s (2020:92) findings

¹ These terms are used by the company Amazon exclusively. However, similar notions are found in other companies as well.

for Amazon's South Californian centres, where some variation exist in standards across centres, department, and location, and with Atzeni's (2023:193) account of Mercado Libra. However, Bangalore associates report uncertainty in expectation of sanction that exacerbates their feelings of vulnerability. While these cases suggest some supervisory discretion that qualifies a fully deterministic, algorithmic logic, they also indicate its very narrow parameters. Supervisors and managers are hugely constrained, for they too are subject to performance metrics, responsible for aggregate target fulfilment and the errors of those they manage. To re-iterate a central argument of this article, algorithmic management, contingent on obligatory, relentless code scanning by workers that embeds data on the WMS, imbricates each detailed task at every stage of the labour process, generating extensive data on workflow progress and individual worker performance simultaneously. However, it is management's *evaluation* of this data that is decisive in determining corrective action, discipline, continued employment – or termination – of workers.

Testimonies are replete with experiences of strict time targets, punishing workloads, ever-present monitoring, micro-management, and interventions when individuals do not 'make the rates'. A picker elaborated:

"Meeting target is a continuous pressure and tension in our work. The demand can go as high as one pick in thirty seconds. Afterall, I have a limit to how much I can run [between one rack to another] that is also with a heavy trolley".

Taking another typical case from participant observation, a picker reported an occasion when his handheld scanner stats informed him that he had only picked 92 items in the past hour, falling short of the stipulated 120. The picklist had been challenging—the inaccessibility of items, the distances between them, and the fact that most were large – for which no account had been taken. He recalled verbatim his scanner's pop-up message:

Hi, Suresh Kumar. In the past one hour you have processed 10 units. You are at the bottom 25% of the company for this function. Try to improve your rates by following the best practices.

This alert was immediately followed by the loudspeaker announcing his and others' names instructing them to meet their manager. In contesting this statistic's accuracy, it transpired that his ID was not logged off at the end of the previous day's shift, so his current measurements were greatly understated. This telling episode reveals fallibility in the algorithmically programmed WMS. Moreover, adherence to metrics dominates workflow and order processing, but they are inflexible, and insensitive to potential complexities of task fulfilment that make targets difficult, even impossible, to achieve. Apropos a core argument of this article, control through digital architecture—scanning and the WMS—generates abundant data but, insofar as workers' performance is concerned, active supervisory intervention is required for this data to be acted upon.

Other reported vulnerabilities and insecurities arises from employee contracts. Figure 3 generalises to the e-commerce sector, indicating a significant and growing percentage of workers with no written job contract. Testimonies and the

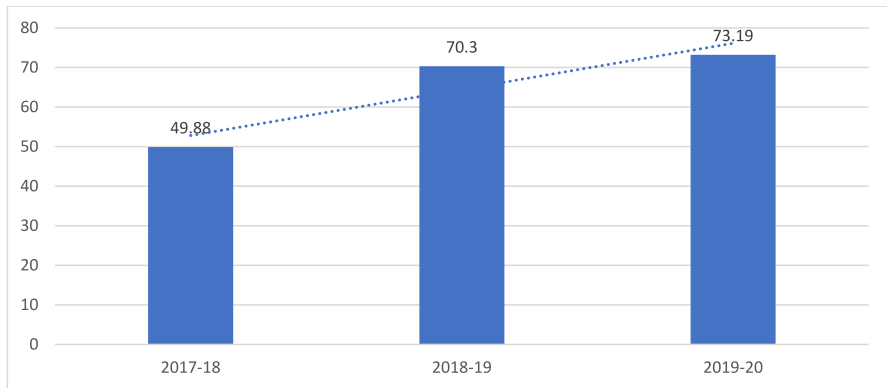


Fig. 3 Percentage share of E-Commerce workers in India with no written job contract in India. *Source:* Calculation from multiple rounds of Periodic Labour Force Survey (PLFS) unit level data (The PLFS of India is a nationwide household survey conducted annually since 2017 by the Ministry of Statistics and Programme Implementation (MoSPI) on the labour force, employment, and unemployment situation in India.)

respondents' job profile (Table 2) demonstrate the prevalence of insecure, short-term temporary contracts, and subcontracted employment through recruitment agencies (third-party contracts). This article evidences the vulnerabilities emanating from the harsh, discretionary, but digitally generated, supervisory practices, coupled with opaqueness in issuing feedback forms and warning letters, that create inescapable tension among the workers. Job insecurity is exacerbated by short-term monthly contracts and limited employer's obligation to workers as an overwhelming majority, notably at Amazon and Flipkart are not contractually engaged to e-commerce firms.

6 Discussion and Conclusion

Much recent academic attention and policy prescription has centred on the emergence of 'new, new technologies (Howcroft & Taylor 2022), innovation in and the extensive application of digital technologies, automation, the cloud and AI to all spheres of economic life. Rahman and Thelen (2019), in an influential article, analysed the development of the platform capitalism. Rather than lapsing into the fallacy of a determinism that ascribes an autonomous power to technological artefacts, a *deus ex machina*, that prescribes inevitable work futures (Joyce et al. 2023), social scientists can make a valuable contribution by investigating the *concrete* ways in which digitalisation is being implemented at sectoral and workplace levels. Speculation regarding utopian or dystopian futures is no substitute for theoretically informed, empirically rich studies that investigate the precise ways that digital technologies are embedded and their consequences. E-commerce is ripe for investigation, given its exponential growth, and characterised by the apparently seamless transmission of orders from vendors to end-customers through digital platforms,

warehouses and delivery hubs. For example, among 6.8 million gig workers in India engaged in jobs mediated through digital platforms, retail, transport, and storage services has created the greatest number, their share increasing substantially from 30 per cent in 2017 to 50 per cent by 2020 (NITI Aayog 2022). Attention has inevitably focussed on the operation of enterprises, the political economy of e-commerce and customer fulfilment.

The article makes a significant contribution in rendering visible and analysing the hidden abode of warehouse work from the perspectives of Indian workers employed in them. However, it does more, for it draws on LPT to analyse the ways in which technological, digital controls, are enmeshed with human supervisory agency to construct a distinctive labour process. A central concern of LPT, with its point of production focus, is to understand the means by which labour power is converted into value generating concrete labour. From the wealth of first-hand evidence of a large cohort of employees at Bangalore warehouses and from participant observation, compelling findings emerge. Firstly, the workflow of orders through the warehouses are subject to functional segregation and detailed divisions of labour, where workers perform repetitive 'fragmented but interconnected tasks (receiving, stowing, picking, packing, dispatch) that recall Braverman (1974) or, for that matter Adam Smith's account of pin manufacture, in the interests of maximising efficiency. Secondly, at every stage, each item is logged by scanning bar or QR codes onto a WMS, the digital platform, that counts, collates, and monitors their location and progress. Thirdly, for each detailed task and each item, individual workers are logged-on, and their performance is micro-monitored. Fourthly, and a crucial argument, while digitalisation generates copious data on workers' performance it is the construction by managerial agency and decision on metrics against which their performance is adjudged acceptable or unacceptable. The system generated data on individual volume and time targets, errors, 'idle time', 'Fast Start' or 'Strong Finish' merely form the basis for supervisory intervention, which manifest in corrective actions or discipline. Fifthly, the precariousness that workers report so fulsomely derive not merely from intense workloads, target pressure and the threat of being deemed underperformers, but from insecure contracts, mostly through third-party intermediaries that leave them vulnerable to dismissal every month.

Evaluating these findings alongside other studies reveals that the impact of algorithmic management on work intensification and labour control in Indian e-commerce warehouses bears striking similarities to those documented in developed countries; the UK (Briken & Taylor 2018), Italy (Delfanti 2021), USA (Struna & Reese (2020), France and Italy (Massimo 2020), not least in the exercise of 'algorithmic bureaucracy'. The Amazon Warehouse System is identified as the universal, digital platform, the technological architecture overseeing orders as they transition through the warehouse, its sequential functions and attendant divisions of labour (receive, stowing, picking, packing, dispatch), while simultaneously micro-monitoring each worker's performance (making rates, errors). The most compelling comparisons with the Bangalore case may be Struna and Reese (2020), Delfanti (2021) and Briken and Taylor (2018), who articulate most definitively the essentiality of barcode and QR code scanning that underpins management by algorithm.

By contrast, the extent of robotisation and automation prevalent in some, but far from universally in, US and European warehouses, is not evident in India. Instead, findings resonate with those from the Global South, where adoption is limited, partly due to availability of cheap labour, which deters its substitution (Atzeni 2023). Constraints on robotisation and even forms of mechanisation, identified by Gutelius and Theodore (2019), appear apposite in the Indian case. Put bluntly, there are no Kivas in Bangalore. Nevertheless, algorithmic management, even in the absence of robotisation and automation, has significantly intensified work, adversely affecting workers' physical and mental health.

Additionally, technological deskilling enables flexible labour utilisation strategies, often involving temporary workers (Briken & Taylor 2018; Gutelius 2015), recruited through labour brokers or agencies (Atzeni & Kenny 2021), which structurally fragment workforces and accentuate barriers to collectivism. In Bangalore, Amazon's exploitation of both external and internal labour markets, the latter through month-long, performance-dependent contracts, creates intense precariousness, that exceeds even that identified in other studies. In response to the hostile and repressive work environment at Bangalore warehouses, a 'toxic' situation in Atzeni's (2023:191) description, workers' scope for exercising agency is limited. However, it does not silence them. Workers do make attempts, overtly or tacitly, collectively or in an individual capacity, to express discontent in word and deed. Instances of workers' deliberate shirking to delay production, refusal to comply with operating protocols, and tampering, if not sabotaging, equipment to leverage some spaces of escape, a degree of autonomy, are sporadically observable. Systematic analysis of worker resistance to managerial control, however, lies beyond this article's scope.

Regarding the effects of national institutional/regulatory frameworks on work, employment, the labour process and employment relations at Amazon and e-commerce warehouses, a focus of several studies (Atzeni 2023; Atzeni & Kenny 2021; Briken & Taylor 2018; Kassem 2023; Massimo 2020), it should be acknowledged that India is characterised by a long history of high informalisation and limited enforcement of labour regulations (Kannan & Papola 2007). However, generalising from India to the entire Global South is inappropriate, for the Argentinian case, by contrast, demonstrates a relatively strong national industrial relations framework and workplace trade unionism, notwithstanding Mercado Libre's, formally legal, union marginalisation practices (Atzeni 2023). Amazon in the global north pursues anti-union strategies (Alimahomed-Wilson & Reese 2020). Even where obliged to accept regulatory requirements and engage with works councils and unions, it strives to exploit legislative loopholes and diminish union effectiveness in the face of strikes and worker struggles (Boewe & Schulten 2017). The 'crucial battlefield' (Massimo 2020:141) may indeed be not over collective bargaining, but in the exercise of control at the point of production and hiring strategies that deliver flexibilisation and greater informalisation. The latter, though, are in extreme form India where casualisation is integral to labour utilisation, even encompassing floor managers. Moreover, the legacy of the limited involvement of Indian's traditional politically-affiliated trade unions in the country's informal sector, especially when compared to unions in other developing countries, like Brazil, Argentina, and South Africa, significantly hampers workers' ability to build effective resistance. However, a growing

awareness of the need to organise is evidenced by new labour activist bodies and trade unions, such as the Amazon India Workers Association and the All-India Gig Workers Association, among others.²

To conclude, this article makes a pioneering contribution, representing to the authors' knowledge, the first systematic attempt to analyse management control, labour processes, and experiences of work in India's e-commerce warehousing. Certain authors claiming to be in the LPT tradition have come to tread a 'technological deterministic' path by emphasising how technologies make more objective, neutral judgements of workers' performance than humans (Christin 2017). Others, convincingly, contest that in technologically-driven work systems, human managerial control not only persists, but remains pivotal for critical decision-making regarding work organisation and controlling workers (Howcroft & Taylor 2022; Newlands 2021). This article contributes to the latter by focussing on how digitalisation in Indian e-commerce warehouse complements managerial agency by providing more granular and comprehensive data on worker's performance that facilitate micro-management. Nor does technological control abjure the importance of bureaucratic controls, for in these warehouses disciplinary measures, hiring and firing practices that exploit an external 'reserve army of labour', payment systems and the nature of job contracts are instrumental in creating profound worker insecurities.

Appendix 1

See Table 1 and 2

Table 1 Demographic profile of respondents

Category	Number of respondents
<i>Age</i>	
18 -20	13
20–25	33
25–30	23
> 30	5
<i>Education</i>	
< 8th Standard	13
8–10th Standard	18
11–12th Standard	23
Diploma	5
Graduate and above	16
Total number of respondents	74

² For details see: <https://www.newsclick.in/amazon-workers-protest-india-black-friday-demand-fair-wages-right-join-unions>

Table 2 Job profile of respondents

Category	Number of respondents
<i>Company</i>	
Amazon	29
Flipkart and E-Kart	16
Myntra	15
Others*	14
<i>Job role</i>	
Picker	30
Packer	9
Stower	4
Sorter	11
Loader/unloader	10
Driver	6
Other**	4
<i>Nature of contract</i>	
Direct contract	15
Third-party contract	59
<i>Duration in work</i>	
< = 1 Month	26
1 month–6 months	21
6 months–1 year	8
> 1 Year	19
<i>Average monthly earning (INR)</i>	
< 10,000	2
10,000–13,000	12
13,000–15,000	25
15,000–20,000	25
> 20,000	10
Total number of respondents	74

*Others includes 4 respondents from Shadowfax. 2 each from ARBFL, Mahindra Logistics, Udaan Logistics and Spoton Logistics, 1 from Delhivery and Ecom Express. **Other post comprises 2 inventory and quality auditors, and 1 from safety department and security

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Declarations

Conflict of Interests The author wishes to state that there is no conflict of interest of any sort in the article being submitted.

Ethical Approval The interview schedule and methodology for this study was approved by the Ethics committee of the Department of Work, Employment and Organisation of University of Strathclyde.

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