

# Organizing in the End of Employment: Information Sharing, Data Stewardship, and Digital Workerism

Dan Calacci  
dcalacci@media.mit.edu  
MIT Media Lab

Cambridge, Massachusetts, USA

## ABSTRACT

Algorithmic management, decentralized workforces, and on-demand labor models have deeply shifted traditional employment relationships. These technologies have concerning implications for workers' ability to exercise labor rights, build collective power, and exercise autonomy at work. In this paper, I argue that worker-led technology design and data-driven research is a key step to ensure fair working futures under these conditions. First, synthesizing scholarship from legal, economic, and HCI fields, I outline the complex reasons behind why many modern workers suffer from an "information asymmetry" at work, and argue why it will likely expand broadly to knowledge work. I then argue that data sharing is an important way that workers can counter algorithmic and data-driven management to improve working conditions, making the case that access to information is a crucial part of labor organizing. Finally, I argue for researchers in the CHI and CSCW fields to engage in a new kind of "Digital Workerism": worker-led research into data collection, analysis, and governance tools that could help provide the labor movement in the US with the tools to change the course of worker power.

## CCS CONCEPTS

• **Human-centered computing** → **Collaborative and social computing**.

## KEYWORDS

labor, work, organizing, participatory design, data governance

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## 1 INTRODUCTION

The current era of work can be defined at its boundaries: algorithmic management, disaggregated workforces, and on-demand market models. These methods and technologies, replacing human

relations, the social arena of the workplace, and labor-centric markets, are causing a major upheaval in modern work. While large, disaggregated workforces in service and delivery industries are often the poster-child for this shift in employer relations, they are not the only areas these technologies will uproot. Freelancers, artists, and knowledge workers are not being replaced by robots – their bosses, managers, and marketplaces are being augmented and extended by them, raising the specter of future disaggregated and unorganized workforces managed by opaque algorithms that are difficult to audit without new tools.

For many workers being managed by an algorithm, their experience is one of multi-faceted data asymmetry, directly informed by the history of computational social science and data-driven behavior change. Instead of receiving strict scheduling and directives, workers are delivered behavioral “nudges” to accomplish a variety of managerial goals, ranging from extending a worker’s shift to encouraging them to accept jobs they otherwise would not. These management decisions are increasingly a core part of workers’ lives, yet workers often have no recourse, input, or transparency into these decisions. For future workers to exert some power over their work, for the government and advocates to audit labor conditions, and for researchers to better understand the future of work & exploitation, information about workers’ conditions, compensation, and relations with their new algorithmic managers must become more transparent and accessible.

One way for these relations to be made transparent is by focusing on the information that workers produce at work. While workers have always been under the surveillant thumb of managers and bosses, perspectives on data ownership rights have shifted in recent years. In this article, I make the case for researchers in the CSCW and CHI communities to focus on building digital tools with workers as a means of both facilitating access to already-existing labor rights and creating a countervailing force to the one-sided information asymmetry currently endemic in the world of work. I first explore and outline some of the complex reasons that modern workers suffer from information asymmetry at work and argue that platformed, surveilled work will expand much farther than some predict. I then discuss the reasons why access to information is and will continue to be crucial to worker organizing, and how data-driven and algorithmic management impact workers. Finally, I argue for a new “Digital Workerism”: a move towards worker-led research into data collection, analysis, and governance tools that the CHI and CSCW communities are uniquely positioned to lead, and why it would be transformative for the worker movement, particularly in the US.



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## 2 HOW POLICY AND TECHNOLOGY ARE CREATING AND SPREADING DATA-DRIVEN AND ALGORITHMIC MANAGEMENT

The rise of data-driven management practices that pervade modern work are not simply the product of an increasingly online society. Instead, it is a downstream effect of a tangled web of both modern policy and technology. Antitrust, tax, and employment law all work in tandem to disincentivize traditional employment relationships and cripple democratic, decentralized working arrangements [2, 28, 62, 67]. Automation promises firms the future of labor-free work, tempting a complete exit from the labor market entirely and encouraging firms to organize around this promise at the expense of workers. Meanwhile, technological advancements mean that managing and directing an entirely decentralized, fragmented workforce is more achievable than ever before—including in fields many judge as “un-automatable”. This section outlines the legal and technical realities that are further incentivizing firms to fissure work through technological management, discusses their impact on workers, and argues that fissured work, and thus, data-driven management, is spreading and will continue to spread.

### 2.1 Fissuring, the End of the Employment Relationship, and its Effects

In the world of labor studies, economics, and law, “Fissuring” refers to the phenomenon of firms breaking apart traditional employment relationships and rights in favor of independent contracting arrangements [83]. These arrangements vary from firms simply outsourcing labor to other firms to using sites like Upwork and Fiverr to hire individual contractors on a temporary basis, rather than hiring full-time or even part-time employees [28, 64, 83].

There are two main reasons why firms are increasingly fissuring and atomizing their workforce. As David Weil convincingly argues in his book *The Fissured Workplace*, labor costs beyond wages, such as overtime laws, payroll taxes, and liability costs can act as a tax on employers that directly engage in the labor force [83]. Retreating from the traditional labor market by hiring workers only on contract or outsourcing liability to other firms reduces this cost significantly [5, 20, 28, 83, 84]. Second, modern technology (much of it developed in the CSCW and CHI literatures) makes automatic or augmented coordination of contract workers more efficient than ever before [28, 85].

In the CHI and CSCW communities, this shift has mainly meant increased attention to contracting “platform” structures like Uber and Lyft, or crowdwork platforms like MTurk, whose entire business models rest on low-paid contracted labor. But these “fully” fissured firms are in the minority—many other kinds of firms fissure in other ways, outsourcing only a portion of their workforce or contracting out specific kinds of jobs. In addition, fissured work is diffusing into the broader working population, including already self-employed workers. Surveys of employment status in the U.K. have shown a rapid rise in the number of workers that report employment income in addition to self-employment, suggesting that many workers are “topping up” their normal income with gig work [1].

The fissuring of the workplace, especially in the US, has a broad array of downstream effects on workers. First and foremost, fissuring excludes large groups of workers from the bevy of entitlements and welfare programs that Catherine Estlund refers to as the “fortress of employment” [28]. The social and legal systems that provide American workers with insurance, retirement security, and other benefits are tightly bound with the notion of a long-term employment relationship (and are the very things that cause employers to move towards fissuring in the first place) [28, 62, 77]. As workers enter what Katherine V.W. Stone calls the “boundaryless” workplace (often as contractors), and the traditional employment relationship disintegrates, these safety nets disappear with it [77].

The advent of fissuring also puts severe downward pressure on workers’ ability to organize and collectively bargain with employers [84]. As companies outsource labor to smaller firms, those workers’ “primary” employers under labor law are no longer those directly responsible for their conditions [62, 85]. For example, a coordinating firm without a physical office hired by a large company might be the direct employer of a group of cleaners or janitors. While these workers may work each day in the larger company’s halls, be directed by the larger company’s management, and be berated by the larger company’s staff, they are not the larger company’s workers under law. Their work conditions might be effectively determined by their worksite, but they have no bargaining power with the large company under current labor law [32, 76].

For workers who are “gig” workers under the thumb of an algorithm, such as Uber drivers or Instacart shoppers, the issue is compounded. First, the absence of a physical workplace and tools to coordinate with other workers means that building power as a gig worker is extremely difficult. Gig work apps are designed to pit workers against one another in a way that actively disincentivizes collectivism [6, 19, 71, 78]. Second, antitrust law actively works against collectives of drivers that seek to organize themselves in a cooperative manner [64]. Uber, as a central coordinating authority, is free to set “independent” drivers’ prices through their platform. Yet, if a group of drivers decided to work directly with customers and set prices together as a bargaining unit through an app or other mechanism, they would, as Sanjukta Paul acknowledges, be labeled a “garden variety price-fixing ring” [64]. This is not just a thought experiment—it has impacted real workers’ wages and bargaining. In Seattle, shortly after the Teamsters lobbied for and won a law that allowed drivers to unionize, the US chamber of commerce sued the city, citing antitrust law [46].

### 2.2 Platformed and Fissured Work Will Expand

Fissuring is much broader than the popular imagination of “gigified” work that brings to mind images of drivers for Uber and Lyft or gig workers delivering meals in cars or scooters. Yet, a common narrative is that the data-driven management practices that “platforming” or “gigification” represent will be relegated to this sort of low-wage work characterized as “non-cognitive” by HCI scholars—the same sphere that automation is purported to replace [28]. Despite the appeal of the narrative that automation and fissuring will impact only “unskilled” or service-class workers, there is little evidence that this will be the case in the near future. The history of CSCW is packed with examples of systems explicitly designed

to break down “complex” tasks into simpler ones that are more readily delegated by automated management systems [47]. This suggests that while there may be work too complex to automate, it is certainly possible to break up otherwise complex tasks into atomized, delegatable parts that can be managed in a platformed, fissured context. I refer to this “breaking down” of tasks done using data, information science, and computer science as “data-driven management” [58]. Algorithmic management is then a logical extension of data-driven management, occurring in contexts where tasks are then assigned according to an automated process.

One has to look no further than Amazon Mechanical Turk to see that this is the case [35]. Popular journalism, scholarship, and activism have paid attention to the working conditions of crowd workers, documenting the low pay rates and one-sided nature of platformed labor on sites like MTurk [35, 41, 72, 73]. Yet the actual work done on MTurk is largely characterized as “ghost work”, labor performed by humans to train algorithms with the goal of automating atomic, cognitive tasks such as labeling images or translating sentences [35, 43]. This simplistic characterization obscures the long line of inquiry into how everyday cognitive tasks—writing, translation, even creative brainstorming—can be delegated to the crowd.

Much of the research being done through MTurk investigates how crowd work can be leveraged to perform complex, context-dependent tasks [50, 51, 59, 61, 69, 79]. Although using algorithmically-guided delegation or management to complete complex tasks like programming have been investigated [86], writing has served as the gold-standard task for systems aimed at delegating and distributing complex creative work [31]. Traditionally considered a task done by individuals or small groups of collaborators, writing is considered the “white lab rat” of HCI research— it is an easily interpretable task that does not naturally decompose into delegatable parts.

Since the earliest crowd research on how to delegate and distribute writing tasks to crowds of workers in 2010, the field of “writing with crowds” has developed into its own subfield of HCI and crowd work [31, 59]. In 2016, a group of researchers from Carnegie Mellon and Microsoft Research tested a system that allowed authors to effectively draft entire sections of research papers by delegating writing tasks to dozens of crowd workers from a smartwatch interface [61]. Their system included an automated “observer” that managed crowd workers for writers, allowing writers to draft entire sections of complex pieces of work from only bullet-point outlines. Other recent projects include systems that coordinate crowd workers to generate creative fiction ideas through roleplaying [40] and entire “full-loop” systems that generate fiction from start to finish using advanced delegation and automated management techniques [49].

It should come as no surprise that platformed and crowd systems often result in less agency for the atomized creative worker. As one recent survey of the field notes, “In crowd-writing systems, control over the writing is carefully managed by the system, yet rarely in the hands of people within the crowd.” [31]. In fact, many of the systems note that removing agency from crowd writers actually improves the final written artifact [74]. Breaking up creative tasks into crowdwork inevitably leads to a loss of agency and autonomy in the work itself.

Core characteristics of these systems also mirror the historical development of scientific management and piece-work, further shoring up the specter that full-time creative employment may be headed towards heavy fissuring without near-future changes to work and policy. Vera Khovanskaya, an HCI researcher and historian, argues convincingly that the decomposition, delegation, and oversight patterns of crowd work formalize and entrench patterns of management first employed under Taylorism in the 20th century [47, 48]. Others have examined crowdwork such as the systems discussed here through the lens of piecework, concluding that crowd work is a “contemporary instantiation of piecework” [6]. It is not difficult to see how a centralized ‘writer’ managing dozens of crowd workers could translate into a modern fissured workplace managing hundreds of disposable crowd workers, each creating content for piece wages.

While it may be impossible to automate creative, cognitive, and “context-dependent” work with an algorithm, it is increasingly possible to decompose, delegate, and oversee it with algorithms and technology. Algorithmic and technological advancements in modeling and facilitating distributed work will enable firms to further fissure tasks we now see as “un-automatable”. Given the potential spread of technologically-augmented management, the greatest near-future impact on working futures is likely to be these advancements, rather than job loss from automation.

### 2.3 An Expansion of Platformed Work Means an Expansion of Surveillance and Data-Driven Worker Control

An expansion of data-driven and algorithmic management techniques such as those deployed in crowd work also means an expansion of surveillance and control over workers. A pre-requisite for data-intensive management of workers, workplace surveillance has ballooned in recent years [4, 8, 13]. The majority of US companies monitor their employees’ internet use or log workers’ keystrokes [4]. Many other companies enroll workers into health and wellbeing programs that collect sensitive data on worker behaviors and health habits [4, 8, 38].

The coronavirus pandemic has also hastened the surveillant workplace, with employers of teams that now work from home more eager than ever to monitor their employees’ days [7]. Workers have been required to install software on their computers and phones that track their location, take screenshots of their computers, and record them through their webcams, all in the name of productivity [7, 75]. As the boundaries between one’s working life and personal life dissolve, so do the limits on the surveillant reach of employers [16].

While this data is not always collected with the explicit purpose of training algorithmic or data-driven management systems, such datasets become the necessary infrastructure for data-driven and algorithmic management to function. Like in the platformed context, the general underlying rationale behind surveilling workers is to optimize productivity—not to just ensure good-faith activity from workers [53]. “Bossware” and “Tattleware”—common names for workplace surveillance software—should also be seen as a stepping stone towards automated management of creative work. The natural extension of the logic of optimizing productivity quickly moves

beyond bespoke analysis of data trends in a firm’s workforce (say, to optimize a quarter’s productivity or decide which workers to let go) to highly automated processes driven by this same data [23]. This can be seen in the translation of increased worker surveillance in the hiring process into automated hiring tools with clear civil rights implications [3, 16].

### 3 WHY WORKERS NEED ACCESS TO DATA TO BUILD POWER UNDER ALGORITHMIC AND DATA-DRIVEN MANAGEMENT

Algorithmic and data-driven management systems, fuelled by worker surveillance, will spread more broadly, including into “creative class” work. As is the case with platformed work, these systems have implications for workers’ ability to exercise labor rights, their autonomy, and ability to collectively build power. Information collected by firms is wielded against workers in ways they have little control over, defining workers’ relationships to both the firm and each other. Value is extracted from workers beyond the traditional labor relationship—data becomes a new form of production that workers participate in, simply by being instrumented. The social and organizational structures that these processes incentivize, with centralized, impersonal managements overseeing at times a veritable army of workers with little interaction and few social ties, breaks down the social fabric that holds potential for worker power in the first place. Meanwhile, the thick spread of surveillance, the bedrock of algorithmic and data-driven management practices, violates fundamental liberties, impacts worker mental health, and limits worker agency.

How can (and do) workers fight back? In this section, I address some of the largest impacts that this process has on working conditions, and discuss their implications for worker power. I then offer examples of the strategies that workers and coalitions are using to fight against data-driven management, and outline the legal and technical obstacles that these strategies pose for workers and allies.

#### 3.1 How Data and Algorithmic Management Systems Impact Workers and Limit Worker Power

Access to information is core to the way that data-driven management systems control workers. As Alex Rosenblat and Luke Stark expertly demonstrate through a deep study of Uber, a core mechanism platformed working arrangements use to exert control over workers is information asymmetry. This refers to the ways that platforms and algorithms strategically limit the information made available to workers in order to incentivize certain behaviors [71]. For example, by limiting the fare data available to drivers when they accept a job, platforms like Uber and Lyft effectively ensure that drivers have limited choice in the jobs they accept. Such strategies are considered a form of “soft control” that platforms exert over workers in lieu of more traditional working directives.

The advent of “soft control” practices can make communicating worker grievances, a core tool in organizing and building worker coalitions [25], much more difficult. Grievances make legible the impacts that specific working practices—changes in pay, hour shifts,

or workplace treatment— have on workers. Compared to traditional workplace changes, the changes instituted by “soft control” of workers through UX nudges, black box algorithm updates, and information withholding is more difficult to communicate and delineate. The result is that for issues as fundamental as pay, even well-organized workers can struggle to communicate exactly what changes have impacted them. The conversation then becomes one about transparency, rather than a specific policy change that could have more political impact. Community forums are awash with threads started by complaints about pay but that result in conversations around transparency and theorizing about company motivations instead [34].

Data-driven management practices, particularly in combination with fissuring, also create environments that limit the potential for collective action between workers. By limiting the amount of information that workers have about others doing the same work, fissured digital platforms stymie collective action. In a study reconsidering crowdwork through the lens of piecework, scholars note that without explicit, intentional spaces designed to build working relationships and collectivism, many crowdworkers do not engage with other workers socially at all [6]. The digital spaces that are built to fill this void have often been created through collaborations with researchers and tech workers [41, 73], or are themselves hosted on closed platforms such as Facebook. This notion of built “space” is core to how decentralized groups of workers have managed to organize themselves globally, including ridesharing, delivery, and other platform work [10, 44, 87].

Workplace monitoring practices that facilitate data-driven management also fundamentally impact worker wellbeing and dignity. The reach of wearables, automated screenshots, location data, and other extenuating “limitless surveillance” can generate stress and feelings of alienation [60]. They also greatly expand the managerial prerogative of employers far beyond what employment law and the social norms of work have traditionally encompassed [23]. For some, this expanse is an affront to personal worker dignity and agency that requires explicit legal intervention or new approaches to algorithmic management entirely [55].

The information that workers generate while at work is also valuable. Creating value from worker data—not just their labor—is what scholars Niels van Doorn and Adam Badger call dual value production [81]. Firms obviously benefit from the use of data that workers produce, such as through further developing algorithms that automate work processes, make existing systems more efficient, and create new products. They also profit, however, from the “speculative value” of the data: data as assets to be traded and sold, or data as a promise of a future, more efficient firm that has yet to be optimized [45]. This mechanism is an additional way that firms are able to extract value from workers.

#### 3.2 Information Collection and Sensemaking Has Always Been Core to Worker Organizing

A core operating throughline for organizing generally, but especially for worker organizing, is information collection, sensemaking, and communication. Early studies of how labor unions operate were quick to point out that rather than only creating leverage

over employers by threatening to quit, unions leveraged information and “voice” to understand both worker and employer interests [33, 39]. The idea of worker “voice”, in this context, refers to the notion that “workers can collectively understand their aggregate desires” [62], clearly an information-driven practice. More than just an alternative mechanism for leverage, information collection and sensemaking also changes the nature of bargaining that worker groups are able to participate in. Bargaining models of labor economics show that workers are able to fight for the “median” worker, rather than accepting pay rates and working conditions that are amenable to the “least attached” worker in a group, significantly raising conditions for all workers in a collective [33, 62].

In the historical context of scientific management, in many ways the spiritual and intellectual predecessor to algorithmic and data driven management, information was also crucial to worker movements. Common union responses to “time studies” and other industrial-era advancements in workplace monitoring could often be characterized as restricting or manipulating the way that information flowed between workers and management. Strategies in response to scientific management included fighting for data transparency, securing access to full wage and time study data, and using that information in worker-driven processes to “audit” employer wage calculations [47]. The similarities between this historic process and modern “algorithmic audits” of platform algorithms are no coincidence. Information was and is still crucial to worker organizing efforts.

Information sharing and gathering also has deep roots in the philosophy of labor organizing. Worker Inquiry, started in the 1960s in Italy as a response to radically changing working conditions, focused on developing long-term research projects that could characterize workers’ experiences [17, 18, 27, 89]. The inquiry of this time period ranged from rigorous social science research to more general studies of production processes [18]. Worker Inquiry was one part of a general Operaist (translated to “workerist”) project exploring workers’ experience of work and workplaces in Italian factories. While the spread of modern work is much more diverse than the work done by factory workers in Italy in the 1960s, the notion of a Digital Workerism has gained traction in recent years, motivated by the potential power of workers to measure and understand their own working conditions [21, 27, 88].

### 3.3 Data Sharing is an Important Way that Workers Can Counter Algorithmic and Data-driven Management

While information has recently become more central to both the value extracted from workers and to their management and control, data and information sharing have also long been core to worker organizing. The history of labor organizing and theory shows that being able to collect and share data about workers’ conditions generally is crucial for labor movements and worker power. In this context, Rosenblat and Stark’s notion of information asymmetry plays at multiple scales. Individual workers are controlled and limited by information withheld from them. At the same time, worker movements themselves are crippled by the enormous gap between their access to information about workers and employers’ omnipresent gaze. The aggregation of worker data within the labor

movement offers an opportunity to solve this asymmetry, both at the level of the individual worker and at the level of the worker movement more broadly.

Like historical workers fighting to make visible the inconsistencies in employer wage calculations [47], modern workers are using data, data science, and information more generally to resist workplace surveillance, negotiate with algorithmic managers, and access labor rights. The Time Project allows TV workers in the UK to track their working time, aggregating data across workers to characterize the entire industry [68]. Digital wage calculators for platform and traditional workers help uncover wage theft in ways that are easy to access and share [26, 66].

Meanwhile, workers who interact with algorithms on a daily basis, such as workers on Upwork, continually “audit” the algorithms that manage them simply through daily use. Their continual interrogation of the opaque systems they use to find work leads to discovering idiosyncrasies or patterns in how the management systems operate that benefit them. Several studies have illustrated how workers on crowd platforms manipulate the algorithms that govern them in small ways, such as changing the number of hours worked they report to the system in order to achieve a higher worker ranking [42, 80]. Turkoption and We Are Dynamo demonstrate the power of creating spaces to share such information to counter information asymmetry and hold employers to account on crowdwork platforms [41, 73].

In collaboration with researchers and activists, workers are also leading campaigns to audit algorithms that govern their pay. Projects like the Shipt Calculator and Deliveroo Unwrapped demonstrate examples of full-circle projects that involve collecting, aggregating, and analyzing data from workers for a specific campaign goal [22, 63]. The Shipt Calculator allowed workers to collect and share their pay records from Shipt, Target’s delivery service company. By aggregating this data, the tool tracked how an opaque change to Shipt’s payment algorithm impacted worker wages. While Shipt claimed that worker pay would increase under the new algorithm, the worker-led audit offered a powerful counternarrative. Analysis of the aggregated pay data showed that under the new algorithm change, 40% of workers received a pay cut and that many earned estimated wages well under their state’s minimum wage laws [22].

## 4 BUILDING A DIGITAL WORKERISM: HOW THE CHI AND CSCW COMMUNITIES CAN HELP

While workers are leading the charge to take hold of their own data for organizing, it is not an easy task. Existing tools and frameworks for data access and analysis are not designed for collective stewardship, governance, sensemaking, or decision-making. Existing law that applies to data ownership appear as hurdles that workers actively fight against in order to use their own data in organizing. Concepts of data privacy, which exist mainly in an individual frame, conflict with a collective rights approach to information [62]. Collecting, aggregating, and analyzing data also requires skills and logistical capacity that can be difficult for workers to access. The skills needed to collect, aggregate, and analyze data are concentrated in the tech companies that build and maintain the very

infrastructure that creates the information asymmetry at the core of worker data tensions. Tools that facilitate no or low-code analysis and collection are few and far between.

Even with these obstacles, there are clear steps that communities like CHI and CSCW can take to strengthen the movement for “worker data science” [37]. Legal and policy scholars adjacent to these communities can take on the issues of collective data use and stewardship as academic and advocacy pursuits. HCI researchers can build tools that make it possible for workers to collect and share data about their working lives in privacy-preserving and accountable ways. Researchers studying algorithms can decide to work on issues related to value-sensitive algorithm design and develop processes to democratize algorithm training and development—both strategies that could help workers have more of a say in any future working conditions governed by algorithms. Low-code and no-code data analysis tools can be researched and developed to help workers untrained in data analysis understand and counter managerial narratives using their own information. Tools to automate subject access requests, one crucial way that workers are accessing data collected about them at work, can be built. Until these things are accomplished, researchers can put workers in positions of participatory power over research agendas, lending worker movements their inquiry skills and voice while answering crucial questions about the working present to inform working futures. All of these steps reinforce and complement each other, creating a speculative Digital Workerism that can be revived to balance the playing field of work globally.

#### 4.1 Obstacles to Data-driven Organizing and Digital Workerism

One of the most fundamental obstacles to building a Digital Workerism lies in how workers are able to access and use information about their working lives. Accessing data about worker experience can be difficult to access or collect. For many workers, the data needed to effectively understand their working conditions, including wages, wellbeing, hours, and treatment at work is collected exclusively by their employer or platform, flows unilaterally from them to the firm, and consists of increasingly complicated and interwoven data. For example, to audit their pay and working conditions, app-based delivery workers might need to collect GPS traces, interaction data from their apps, work history, ratings information, data on each of their orders, and other tidbits. This is already a challenge, but workers do accomplish this even without the convenience of technical tools—it’s just difficult. Workers I’ve interviewed about their data collection practices often use clipboards, excel spreadsheets, and google maps to track information about their own work history. They create custom maps with the best tippers in their working zones, save detailed records of order pay and completion times, and make notes about which orders are more or less difficult and why.

The biggest frustration to these workers is that most of this data is already collected by the apps they work for—it’s just not accessible to them. One avenue to gain access to this information that flows unilaterally from the worker to the platform is Data Subject Access Requests (DSARs), a legal mechanism for consumers to request machine-readable exports of data they produce while

interacting with platforms [12, 52]. Some worker groups such as Worker Info Exchange (WIE), a non-profit group that supports platform workers in the EU, have successfully run campaigns based on data collected through aggregating DSAR information from workers [30]. But generally, scholars have found that even in the consumer realm, DSARs are not adequately accommodated by firms, making them an inadequate singular strategy for collecting data about worker experience [12].

DSARs are also fundamentally limited, as data is a situated object. In the case of DSARs, what data is collected, how it is stored, and what about worker experiences is made legible are all decided from the standpoint of the firm, not the worker. This means that all data collectible through DSARs reflect the position of management and so is limited as a tool for worker inquiry. Information about workplace harassment, mistreatment, and any other information that might be a liability issue to a firm may not be collected or available at all. DSARs have also run aground when considered at odds with the privacy rights of individual consumers. In the May 2021 legal case with Ola and Uber, Uber redacted some GPS data it handed over to WIE, citing concerns for end-user privacy.

Alternatively to DSARs, workers can also collect data about their working lives independently. Worker-organizers are no stranger to this strategy, as organized workers have been using self-distributed surveys and other data collection means to understand working conditions since the dawn of labor organizing. However, as the complexity of modern management and data-driven work shows, traditional methods for measuring worker experience are limited. Understanding how algorithmic changes impact worker wellbeing still requires detailed data that might mimic the information collected by platforms. To quantify the impact of a change in a delivery app’s payment algorithm, information about workers’ GPS locations, driving habits, tip records, and ratings might all be needed.

Analyzing all this data is also technically daunting. In challenging a deactivation by Uber, WIE analyzed a location dataset they obtained through a DSAR about a worker’s driving history [29]. To publicly campaign for this worker, WIE analyzed dense GPS location traces and cross-referenced the worker’s activity to other location records. This task—of analyzing a single driver’s deactivation case—required knowledge of GPS data, geospatial analysis techniques, and data visualization. These are specialized skills that are not readily available to organizers and workers.

Beyond technical capacity and skills, policy and legal hurdles threaten workers’ collective use of their data. Despite the advancement of consumer privacy bills in the US and EU such as the GDPR or CCPA in California, data protection and privacy law effectively extends rights only to consumers, not workers. Data privacy law has an extremely limited reach in the workplace, granting employers broad authority to collect and own information collected from workers. Trade secret protections on data and information created from worker data limit how worker groups can use any information they collect. In some cases, simply sharing wage data could be considered a violation of trade secret law [16]. Workers attempting to use sensor data or reverse engineer workplace algorithms to audit employer practices could face serious legal challenges. Discussing this tension is beyond the scope of this paper, but withholding data rights from workers will have serious downstream consequences for labor movements.

## 4.2 Developing Technology for Worker Inquiry and Data Access

*4.2.1 Building Accessible Tools to Understand Working Conditions.* While serious, all of these obstacles also offer a roadmap for how advocates and researchers can help build a stronger, more capable worker movement that may be more resilient in the face of intense workplace surveillance and data-driven management. Tools like WeClock [82], which allows workers to use their mobile phones as digital sensors and survey tools, are expanding the horizon of what information is easily collectible by workers and organizers. WeClock is built with worker experience in mind, and collects all data on-device by default to protect worker privacy. Workers then send data files to organizers, who can then analyze worker data to estimate wage theft, commute times, and worker wellbeing. More tools like WeClock that allow workers to securely collect and share data about their working life are needed and can be considered active areas of HCI research. There is a dearth of knowledge about how to design tools built specifically for workers. By developing and prototyping such tools researchers can contribute to more general knowledge about how to build technology for workers, as well as grow technological capacity for worker movements.

Workers also desperately need tools that allow them to analyze data collected by tools like WeClock. A cursory review of “low-code” analysis or visualization tools on Google Scholar and other repositories reveals that the vast majority of projects are aimed explicitly at specific industry problems such as logistics, not general-purpose data analysis or visualization. To truly support a modern “worker’s inquiry”, systems that let laypeople investigate data about their own working life, as well as tools that allow them to combine those insights with others’ contributions, are desperately needed.

*4.2.2 Worker-Led Participatory Approaches.* Besides building tools, researchers can also participate in “co-research”, a core part of the philosophy surrounding worker inquiry that is reminiscent of Participatory Action Research [9, 18, 36, 70]. By involving workers in the stages of research planning and design, researchers can help ensure their work contributes to addressing real issues that workers face while adding to broader knowledge. Providing true participation (as opposed to tokenization [11]) to workers can elevate them from research subjects to co-researchers, a practice that can also help build worker groups’ capacity for data-based inquiry.

Researchers seeking to engage with Digital Workerism by designing tools for workers should look to existing organizations for leadership, guidance, and collaboration. Worker centers, emergent labor unions, and community groups that aim to improve worker’s rights likely have challenges that might be easier to solve with better tools or questions that could be answered with better information about workers. However, labor groups are notoriously under-resourced, and it takes persistent outreach efforts from researchers to keep a community-focused project alive.

*4.2.3 Democratizing Algorithm Design.* A small but growing body of research also investigates how the algorithms that govern workers can be made more participatory. Some organizers may protest that it will be difficult (if not impossible) to create algorithmic management systems that are “aligned” between both worker and management interests. However, as long as algorithms are being

used to make decisions about workers’ lives, it stands to reason that we should make every effort to ensure they are at least able to be the subject of bargaining and negotiation. Projects like WeBuildAI offer a roadmap for how to construct algorithms in more participatory ways that take into account differing stakeholder interests [57]. Like WeBuildAI, projects that take on the challenge of investigating participatory algorithms should aim to combine human practices (WeBuildAI was based on an in-person workshop model) with technological advancements that can help make algorithms more democratic.

Even for algorithmic systems that are not co-designed by workers in this spirit, applications of algorithmic explainability in the worker context will be crucial. Labor unions that provided access to wage and time studies in the early days of scientific management were careful to point out the importance of making such information available in laypeople’s terms. While algorithmic explainability is a large and active area of AI research, there is room to focus on how explainability can be transferred to specific contexts, such as work. Such projects could focus on interrogating black-box algorithms, such as the case of workers attempting to deconstruct a pay algorithm’s “black box”. Others might address issues of trust and security in explanation systems to develop systems that ensure workers get a fair look at the systems that govern their lives [14, 54].

*4.2.4 Alternative Data and Labor Governance.* All of these developments can be seen as infrastructure, and while existing structures such as labor unions provide a model for how governance of the data, tools, and algorithms that worker groups might be developed, union density in the United States is at an all-time low. Some unions, such as in the sports industry, provide useful examples of how to include data in a bargaining contract [15], but most workers do not have the ability to join an existing union. Experiments in alternative governance arrangements may be a more strategic way to include more workers, at least in the US. Data cooperative structures could be used as a governance layer both for worker organizing and for data stewardship [65]. “Bottom-Up” data trusts, a model based more on existing legal and governance structures, could also be a fruitful alternative [24, 56].

## 5 CONCLUSION: COMPUTER SUPPORTED COOPERATIVE RESISTANCE

Platform work provides workers, scholars, and advocates with a premonition of working futures, saturated with intensive surveillance, loss of autonomy, and limited worker rights. But it does not have to be this way. The solutions presented here are far from a panacea—they will not stop the policies that have fissured working environments and incentivize the misclassification and digital control of workers. But they may help chart a path forward for researchers and advocates seeking to change the course of worker power in an increasingly digitized working world.

While researchers in the CSCW and CHI communities are members of an intellectual lineage that has in some ways facilitated the spread of technology that now controls and limits worker power, it is these same fields that are best equipped to create the tools that might resist an oppressive working future. As the world of work is increasingly digitized, workers will need new digital tools to

make legible their experiences and interrogate, audit, and shape the systems that control their working lives. As Karen Gregory notes, data and digital tools are not a replacement for the hard work of organizing, but they clearly can help balance the tilted playing field. Examples of worker-led digital resistance like the Shipt Calculator, Deliveroo Unwrapped, and others all point to the potential for digital tools to help workers build solidarity and hold employers accountable.

In a modern economy whose ailments—massive inequality, poor working conditions, and little autonomy—have been pegged to the past century's precipitous decrease in labor power [76], building tools and systems that use data to help workers organize may also construct a more sustainable future. The promise of working futures is not only in the hands of employers and the firm. It is in the hands of workers, and those who might do the work with them.

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## REFERENCES

- [1] Abi Adams, Judith Freedman, and Jeremias Prassl. 2018. Rethinking Legal Taxonomies for the Gig Economy. *Oxford Review of Economic Policy* 34, 3 (2018), 475–494.
- [2] Jeremias Adams-Prassl. 2019. What If Your Boss Was an Algorithm? Economic Incentives, Legal Challenges, and the Rise of Artificial Intelligence at Work. *Comp. Lab. L. & Pol'y J.* 41 (2019), 123.
- [3] Ifeoma Ajunwa. 2021. The Auditing Imperative for Automated Hiring. *Harvard Journal of Law and Technology* 34, 1 (2021), 80 pages. <https://doi.org/10.2139/ssrn.3437631>
- [4] Ifeoma Ajunwa, Kate Crawford, and Jason Schultz. 2017. Limitless Worker Surveillance. *Calif. L. Rev.* 105 (2017), 735.
- [5] Charlotte Alexander. 2016. *Legal Avoidance and the Restructuring of Work*. SSRN Scholarly Paper ID 2771462. Social Science Research Network, Rochester, NY.
- [6] Ali Alkhatib, Michael S. Bernstein, and Margaret Levi. 2017. Examining Crowd Work and Gig Work Through The Historical Lens of Piecework. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. Association for Computing Machinery, New York, NY, USA, 4599–4616. <https://doi.org/10.1145/3025453.3025974>
- [7] Bobby Allyn. 2020. *Your Boss Is Watching You: Work-From-Home Boom Leads To More Surveillance*. NPR. Retrieved May 9, 2022 from <https://www.npr.org/2020/05/13/854014403/your-boss-is-watching-you-work-from-home-boom-leads-to-more-surveillance>
- [8] Antonio Aloisi and Elena Gramano. 2019. Artificial Intelligence Is Watching You at Work: Digital Surveillance, Employee Monitoring, and Regulatory Issues in the EU Context Automation, Artificial Intelligence, & Labor Law. *Comparative Labor Law & Policy Journal* 41, 1 (2019), 95–122.
- [9] Romano Alquati. 2019. Co-Research and Worker's Inquiry. *South Atlantic Quarterly* 118, 2 (2019), 470–478.
- [10] Mohammad Amir Anwar and Mark Graham. 2020. Hidden Transcripts of the Gig Economy: Labour Agency and the New Art of Resistance among African Gig Workers. *Environment and Planning A: Economy and Space* 52, 7 (2020), 1269–1291.
- [11] Sherry R. Arnstein. 2019. A Ladder of Citizen Participation. *Journal of the American Planning Association* 85, 1 (2019), 24–34.
- [12] Jef Ausloos and Pierre Dewitte. 2018. Shattering One-Way Mirrors – Data Subject Access Rights in Practice. *International Data Privacy Law* 8, 1 (Feb. 2018), 4–28. <https://doi.org/10.1093/idpl/ipy001>
- [13] Kirstie Ball. 2010. Workplace Surveillance: An Overview. *Labor History* 51, 1 (2010), 87–106.
- [14] Solon Barocas, Andrew D. Selbst, and Manish Raghavan. 2020. The Hidden Assumptions behind Counterfactual Explanations and Principal Reasons. In *Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency*. ACM, New York, NY, 80–89.
- [15] Skyler R. Berman. 2019. Bargaining Over Biometrics: How Player Unions Should Protect Athletes in the Age of Wearable Technology. *Brook. L. Rev.* 85 (2019), 543.
- [16] Matthew T. Bodie. 2021. The Law of Employee Data: Privacy, Property, Governance. *Indiana Law Journal* 97, 2 (2021), 708–754.
- [17] David Broder. 2020. The Autumn and Fall of Italian Workerism. *Catalyst* 3, 4 (2020), 23 pages.
- [18] Patrick Carmichael. 2020. Postdigital Possibilities: Operaismo, Co-research, and Educational Inquiry. *Postdigital Science and Education* 2, 2 (April 2020), 380–396. <https://doi.org/10.1007/s42438-019-00089-0>
- [19] Riccardo Emilio Chesta, Lorenzo Zamponi, and Carlotta Caciagli. 2019. Labour Activism and Social Movement Unionism in the Gig Economy. Food Delivery Workers Struggles in Italy. *Partecipazione e Conflitto* 12, 3 (2019), 819–844.
- [20] Lisa Cohen, M. Diane Burton, and Michael Lounsbury (Eds.). 2016. *The Structuring of Work in Organizations*. Emerald Group Publishing, New York, NY. <https://doi.org/10.1108/S0733-558X201647>
- [21] Digital Worker Inquiry Conference. 2021. *Digital Worker Inquiry: Data, Solidarity, Leverage*. Digital Worker Inquiry Conference. <https://digitalworkerinquiry.com/>
- [22] Coworker. 2020. *Shopper Transparency Calculator 2.0*. Coworker. Retrieved December 26, 2021 from <https://home.coworker.org/shiptcalc/>
- [23] Valerio De Stefano. 2019. "Negotiating the Algorithm": Automation, Artificial Intelligence, and Labor Protection. *Comp. Lab. L. & Pol'y J.* 41 (2019), 15.
- [24] Sylvie Delacroix and Neil D. Lawrence. 2019. Bottom-up Data Trusts: Disturbing the 'One Size Fits All' Approach to Data Governance. *International Data Privacy Law* 9, 4 (Nov. 2019), 236–252. <https://doi.org/10.1093/idpl/ipy2014>
- [25] Marc Dixon, Vincent J. Roscigno, and Randy Hodson. 2004. Unions, Solidarity, and Striking. *Social Forces* 83, 1 (2004), 3–33.
- [26] Lynn Dombrowski, Adriana Alvarado Garcia, and Jessica Despard. 2017. Low-Wage Precarious Workers' Sociotechnical Practices Working towards Addressing Wage Theft. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, 4585–4598.
- [27] Sai Englert, Jamie Woodcock, and Callum Cant. 2020. Digital Workerism: Technology, Platforms, and the Circulation of Workers' Struggles. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society* 18, 1 (Jan. 2020), 132–145. <https://doi.org/10.31269/tripleC.v18i1.1133>
- [28] Cynthia Estlund. 2018. What Should We Do after Work: Automation and Employment. *Yale LJ* 128 (2018), 254.
- [29] Worker Info Exchange. 2021. Uber's Anti Fraud Systems and the Failure of Human Review. Retrieved May 9, 2022 from <https://www.workerinfoexchange.org/post/uber-s-anti-fraud-systems-and-the-failure-of-human-review>
- [30] Worker Info Exchange. 2021. Worker Info Exchange | Data Rights for Digital Workers. Retrieved December 23, 2021 from <https://www.workerinfoexchange.org>
- [31] Molly Q. Feldman and Brian James McInnis. 2021. How We Write with Crowds. *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW3 (Jan. 2021), 229:1–229:31. <https://doi.org/10.1145/3432928>
- [32] The Century Foundation. 2019. The PRO Act and Workplace Fissuring. <https://tcf.org/content/commentary/pro-act-workplace-fissuring/>
- [33] Richard B. Freeman and James L. Medoff. 1984. What Do Unions Do. *Indus. & Lab. Rel.* 38 (1984), 244.
- [34] FuturePastryChef. 2020. V3 Pay Formula.
- [35] Mary L. Gray and Siddharth Suri. 2019. *Ghost Work: How to Stop Silicon Valley from Building a New Global Underclass*. Eamon Dolan Books, New York, NY.
- [36] Davydd J. Greenwood, William Foote Whyte, and Ira Harkavy. 1993. Participatory action research as a process and as a goal. *Human relations* 46, 2 (1993), 175–192.
- [37] Karen Gregory. 2021. *Worker Data Science Can Teach Us How to Fix the Gig Economy*. Wired. <https://www.wired.com/story/labor-organizing-unions-worker-algorithms/>
- [38] Kathleen Griesbach, Adam Reich, Luke Elliott-Negri, and Ruth Milkman. 2019. Algorithmic Control in Platform Food Delivery Work. *Socius* 5 (2019), 2378023119870041.
- [39] Albert O. Hirschman. 1970. *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States*. Vol. 25. Harvard University Press, Cambridge, Massachusetts.
- [40] Chieh-Yang Huang, Shih-Hong Huang, and Ting-Hao Kenneth Huang. 2020. Heteroglossia: In-Situ Story Ideation with the Crowd. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–12.
- [41] Lilly C. Irani and M. Six Silberman. 2013. Turkopticon: Interrupting Worker Invisibility in Amazon Mechanical Turk. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, 611–620.
- [42] Mohammad Hossein Jarrahi and Will Sutherland. 2019. Algorithmic Management and Algorithmic Competencies: Understanding and Appropriating Algorithms in Gig Work. In *Information in Contemporary Society*. Springer, New York, NY, 578–589.
- [43] Phil Jones. 2021. *Work without the Worker: Labour in the Age of Platform Capitalism*. Verso Books, New York, NY.

- [44] Sarah Kaine and Emmanuel Josserand. 2019. The Organisation and Experience of Work in the Gig Economy. *Journal of Industrial Relations* 61, 4 (2019), 479–501.
- [45] Katherine C. Kellogg, Melissa A. Valentine, and Angèle Christin. 2019. Algorithms at Work: The New Contested Terrain of Control. *Academy of Management Annals* 14, 1 (Nov. 2019), 366–410. <https://doi.org/10.5465/annals.2018.0174>
- [46] Sarah Kessler. 2018. *Gigged: The End of the Job and the Future of Work*. St. Martin's Press, New York, NY.
- [47] Vera Khovanskaya, Lynn Dombrowski, Jeffrey Rzeszotarski, and Phoebe Sengers. 2019. The Tools of Management: Adapting Historical Union Tactics to Platform-Mediated Labor. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–22.
- [48] Vera Khovanskaya and Phoebe Sengers. 2019. Data Rhetoric and Uneasy Alliances: Data Advocacy in US Labor History. In *Proceedings of the 2019 on Designing Interactive Systems Conference*. ACM, San Diego CA USA, 1391–1403. <https://doi.org/10.1145/3322276.3323691>
- [49] Joy Kim, Sarah Sterman, Allegra Argent Beal Cohen, and Michael S. Bernstein. 2017. Mechanical Novel: Crowdsourcing Complex Work through Reflection and Revision. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. Association for Computing Machinery, New York, NY, USA, 233–245. <https://doi.org/10.1145/2998181.2998196>
- [50] Aniket Kittur, Ed H. Chi, and Bongwon Suh. 2008. Crowdsourcing User Studies with Mechanical Turk. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, New York, NY, USA, 453–456.
- [51] Aniket Kittur, Boris Smus, Susheel Khamkar, and Robert E. Kraut. 2011. CrowdForge: Crowdsourcing Complex Work. In *Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology (UIST '11)*. Association for Computing Machinery, New York, NY, USA, 43–52. <https://doi.org/10.1145/2047196.2047202>
- [52] Jacob Leon Kröger, Jens Lindemann, and Dominik Herrmann. 2020. How Do App Vendors Respond to Subject Access Requests? A Longitudinal Privacy Study on iOS and Android Apps. In *Proceedings of the 15th International Conference on Availability, Reliability and Security (ARES '20)*. Association for Computing Machinery, New York, NY, USA, 1–10. <https://doi.org/10.1145/3407023.3407057>
- [53] Benjamin Laker, Will Godley, Charmi Patel, and David Cobb. 2020. *How to Monitor Remote Workers—Ethically*. MIT Sloan Management Review, Cambridge, Massachusetts. Retrieved May 9, 2022 from <https://sloanreview.mit.edu/article/how-to-monitor-remote-workers-ethically/>
- [54] Himabindu Lakkaraju and Osbert Bastani. 2020. "How Do I Fool You?" Manipulating User Trust via Misleading Black Box Explanations. In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society*. ACM, New York, NY, 79–85.
- [55] Laura Lamers, Jeroen Meijerink, Giedo Jansen, and Mieke Boon. 2022. A Capability Approach to Worker Dignity under Algorithmic Management. *Ethics and Information Technology* 24, 1 (Feb. 2022), 10. <https://doi.org/10.1007/s10676-022-09637-y>
- [56] Jeremiah Lau Jia Jun, J. E. Penner, and Benjamin Wong. 2019. *The Basics of Private and Public Data Trusts*. SSRN Scholarly Paper ID 3458192. Social Science Research Network, Rochester, NY. <https://doi.org/10.2139/ssrn.3458192>
- [57] Min Kyung Lee, Daniel Kusbit, Anson Kahng, Ji Tae Kim, Xinran Yuan, Alissa Chan, Daniel See, Ritesh Noothigattu, Siheon Lee, Alexandros Psomas, and Ariel D. Procaccia. 2019. WeBuildAI: Participatory Framework for Algorithmic Governance. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (Nov. 2019), 181:1–181:35. <https://doi.org/10.1145/3359283>
- [58] Min Kyung Lee, Daniel Kusbit, Evan Metsky, and Laura Dabbish. 2015. Working with Machines: The Impact of Algorithmic and Data-Driven Management on Human Workers. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, New York, NY, 1603–1612.
- [59] Greg Little, Lydia B. Chilton, Max Goldman, and Robert C. Miller. 2010. TurKit: Human Computation Algorithms on Mechanical Turk. In *Proceedings of the 23rd Annual ACM Symposium on User Interface Software and Technology (UIST '10)*. Association for Computing Machinery, New York, NY, USA, 57–66. <https://doi.org/10.1145/1866029.1866040>
- [60] Phoebe V. Moore, Martin Upchurch, and Xanthe Whittaker. 2018. Humans and Machines at Work: Monitoring, Surveillance and Automation in Contemporary Capitalism. In *Humans and Machines at Work*. Springer, New York, NY, 1–16.
- [61] Michael Nebeling, Alexandra To, Anhong Guo, Adrian A. de Freitas, Jaime Teevan, Steven P. Dow, and Jeffrey P. Bigham. 2016. WearWrite: Crowd-assisted Writing from Smartwatches. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, 3834–3846.
- [62] Nathan Newman. 2017. Reengineering Workplace Bargaining: How Big Data Drives Lower Wages and How Reframing Labor Law Can Restore Information Equality in the Workplace. *U. Cin. L. Rev.* 85 (2017), 693.
- [63] Workers' Observatory. 2020. *Workers Observatory — We See The City*. Workers' Observatory. Retrieved December 23, 2021 from <https://workersobservatory.org/>
- [64] Sanjukta Paul. 2019. Fissuring and the Firm Exemption Work after the End of Employment. *Law and Contemporary Problems* 82, 3 (2019), 65–88.
- [65] Alex Pentland, Alexander Lipton, and Thomas Hardjono. 2021. *Building the New Economy: Data as Capital*. MIT Press, Cambridge, Massachusetts, Chapter Data Cooperatives, 19–35.
- [66] Georgia Fair Labor Platform. 2020. *Wage Theft Calculator*. Georgia Fair Labor Platform. <https://shroma.ge/en/wagetheft-intro-en/>
- [67] Jeremias Prassl and Martin Risak. 2017. The Legal Protection of Crowdworkers: Four Avenues for Workers' Rights in the Virtual Realm. In *Policy Implications of Virtual Work*. Springer, New York, NY, 273–295.
- [68] The Time Project. 2021. Time Project. <https://thetimeproject.co.uk/>
- [69] Daniela Retelny, Sébastien Robaszekiewicz, Alexandra To, Walter S. Lasecki, Jay Patel, Negar Rahmati, Tulsee Doshi, Melissa Valentine, and Michael S. Bernstein. 2014. Expert Crowdsourcing with Flash Teams. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*. ACM, New York, NY, 75–85.
- [70] Gigi Roggero. 2014. Notes on Framing and Re-Inventing Co-Research. *Ephemera* 14, 3 (2014), 511.
- [71] Alex Rosenblat and Luke Stark. 2016. Algorithmic Labor and Information Asymmetries: A Case Study of Uber's Drivers. *International Journal of Communication* 10 (2016), 27.
- [72] Joel Ross, Lilly Irani, M Six Silberman, Andrew Zaldivar, and Bill Tomlinson. 2010. Who are the crowdworkers? Shifting demographics in Mechanical Turk. In *CHI'10 extended abstracts on Human factors in computing systems*. ACM, New York, NY, 2863–2872.
- [73] Niloufar Salehi, Lilly C. Irani, Michael S. Bernstein, Ali Alkhatib, Eva Ogbe, and Kristy Milland. 2015. We Are Dynamo: Overcoming Stalling and Friction in Collective Action for Crowd Workers. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, 1621–1630.
- [74] Niloufar Salehi, Jaime Teevan, Shamsi Iqbal, and Ece Kamar. 2017. Communicating Context to the Crowd for Complex Writing Tasks. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. Association for Computing Machinery, New York, NY, USA, 1890–1901. <https://doi.org/10.1145/2998181.2998332>
- [75] Adam Satariano. 2020. *How My Boss Monitors Me While I Work From Home*. The New York Times. Retrieved May 9, 2022 from "<https://www.nytimes.com/2020/05/06/technology/employee-monitoring-work-from-home-virus.html>"
- [76] Anna Stansbury and Lawrence H. Summers. 2020. *The Declining Worker Power Hypothesis: An Explanation for the Recent Evolution of the American Economy*. Working Paper 27193. National Bureau of Economic Research. <https://doi.org/10.3386/w27193>
- [77] Katherine Van Wezel Stone. 2007. A Fatal Mismatch: Employer-Centric Benefits in a Boundaryless World. *Lewis & Clark L. Rev.* 11 (2007), 451.
- [78] Arianna Tassinari and Vincenzo Maccarrone. 2020. Riders on the Storm: Workplace Solidarity among Gig Economy Couriers in Italy and the UK. *Work, Employment and Society* 34, 1 (Feb. 2020), 35–54. <https://doi.org/10.1177/0950017019862954>
- [79] Jaime Teevan, Shamsi T. Iqbal, Carrie J. Cai, Jeffrey P. Bigham, Michael S. Bernstein, and Elizabeth M. Gerber. 2016. Productivity Decomposed: Getting Big Things Done with Little Microtasks. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. ACM, New York, NY, 3500–3507.
- [80] Niels Van Doorn. 2020. From a Wage to a Wager: Dynamic Pricing in the Gig Economy. *Platform Equality* (2020), 17 pages.
- [81] Niels van Doorn and Adam Badger. 2020. Platform Capitalism's Hidden Abode: Producing Data Assets in the Gig Economy. *Antipode* 52, 5 (2020), 1475–1495. <https://doi.org/10.1111/anti.12641>
- [82] WeClock. 2021. WeClock. <https://weclock.it>
- [83] David Weil. 2014. *The Fissured Workplace*. Harvard University Press, Cambridge, Massachusetts.
- [84] David Weil. 2019. Understanding the Present and Future of Work in the Fissured Workplace Context. *RSF: The Russell Sage Foundation Journal of the Social Sciences* 5, 5 (2019), 147–165.
- [85] David Weil and Tanya Goldman. 2016. Labor Standards, the Fissured Workplace, and the on-Demand Economy. *Perspectives on Work* 20, 1-2 (2016), 26–29; 77.
- [86] Alex C. Williams, Harmanpreet Kaur, Shamsi Iqbal, Ryan W. White, Jaime Teevan, and Adam Fournay. 2019. Mercury: Empowering Programmers' Mobile Work Practices with Microproductivity. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology (UIST '19)*. Association for Computing Machinery, New York, NY, USA, 81–94. <https://doi.org/10.1145/3332165.3347932>
- [87] Alex J. Wood, Vili Lehdonvirta, and Mark Graham. 2018. Workers of the Internet Unite? Online Freelancer Organisation among Remote Gig Economy Workers in Six Asian and African Countries. *New Technology, Work and Employment* 33, 2 (2018), 95–112.
- [88] Jamie Woodcock. 2014. The Workers' Inquiry from Trotskyism to Operaismo: A Political Methodology for Investigating the Workplace. *Ephemera: theory & politics in organizations* 14, 3 (2014), 493–513.
- [89] Steve Wright. 2007. Back to the Future: Italian Workerists Reflect upon the Operaista Project. *Ephemera: Theory & Politics in Organization* 7 (2007), 270–281.