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The Contexts of Control: Information, Power, and Truck-Driving Work

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This article examines the implications of electronic monitoring systems for organizational information flows and worker control, in the context of the U.S. trucking industry. Truckers, a spatially dispersed group of workers with a traditionally independent culture and a high degree of autonomy, are increasingly subjected to performance monitoring via fleet management systems that record and transmit fine-grained data about their location and behaviors. These systems redistribute operational information within firms by accruing real-time aggregated data in a remote company dispatcher. This redistribution results in a seemingly incongruous set of effects. First, abstracted and aggregated data streams allow dispatchers to quantitatively evaluate truckers' job performance across new metrics, and to challenge truckers' accounts of local and biophysical conditions. Second, even as these data are abstracted, information about truckers' activities is simultaneously resocialized via its strategic deployment into truckers' social relationships with their coworkers and families. These disparate dynamics operate together to facilitate firms' control over truckers' daily work practices in a manner that was not previously possible. The trucking case reveals multifaceted pathways to the entrenchment of organizational control via electronic monitoring.

Keywords electronic monitoring, information, organizations, social control, sociotechnical systems, surveillance, trucking, work

Organizational control is increasingly carried out via technological monitoring. Systems that enable comprehensive surveillance of employee activities obviate the need for reliance on managerial fiat and other resource-intensive tools for generating compliance with an organization's aims. As monitoring technologies continue to become lighter and cheaper, we can expect them to proliferate across workplaces and into new settings, where fine-grained control over employees' labor had previously been impracticable: From prompting nurses to wash their hands (Boyce 2011) to preventing restaurant servers from stealing meals (Pierce, Snow, and McAfee 2013), electronic surveillance is fast becoming a favored tool for enforcing workplace rules.

But *how* do these systems operate to exact organizational control? In this article, I explore how electronic monitoring systems reorient information flows in a spatially diffuse work context, the U.S. trucking industry. Truckers, a group of workers with a traditionally independent culture and a high degree of decision-making autonomy, are increasingly subjected to performance monitoring via devices that record and transmit fine-grained data about their location and behavior back to their firms, in real time. As extant research on technology, information, and work might suggest, I find that managers make use of electronic monitoring (and the data it generates) to control workers by making their day-to-day practices more visible and measurable. But the pathways managerial control takes in this setting are surprising, as the data are put to multiple and seemingly incongruous uses. First, monitoring abstracts knowledge from local and biophysical contexts to aggregated databases—arming managers not only with new barometers for comparative performance assessment, but also with a trove of evidence with which to challenge truckers' accounts. Second, organizations enact control by resocializing electronically derived information, strategically deploying it into employees' social lives—truckers' relationships with their coworkers and families—in order to pressure employees into compliance with organizational aims. The simultaneous operation of these multiple dynamics enables managerial control

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over these mobile workers in a manner that was not previously possible.

I proceed by describing the theoretical framing on information, technology, and organizational control over workers. I then offer background on the trucking industry, trucker culture, and the legal and organizational contexts of electronic monitoring in trucking. After a word about the data and methods used in the research, I describe three dimensions of change in information flows under electronic regimes—aggregation, exclusivity, and temporality—and the control dynamics they engender. Finally, I suggest how the truckers' case complicates existing theory about organizational control.

INFORMATION SYSTEMS AND CONTROL OVER WORK PROCESSES

Information systems have long been used to exercise managerial control over workers within organizations (Ball 2010; Beniger 1986; Kling 1996; Yates 1993). A chief mechanism for such control is the abstraction and rationalization of knowledge, a dynamic initially documented in the realm of industrial production (Braverman 1974; Zuboff 1988). Traditional craftsmanship and manual labor are embodied, process driven, and contextual (what Zuboff terms "action-centered"); even contemporary professionalized work very often depends on direct local or biophysical perception of cues (consider Daipha [2007] on weather forecasters and Bailey, Leonardi, and Barley [2012] on auto engineers) and embodiment as a tool for knowledge construction (Vertesi 2012; Prentice 2005, 2007; Myers 2008).

Yet information technologies often attenuate the connections among work, local context, and embodied knowledge. They may do so by automating jobs previously dependent on bodily skill, by breaking up process-based knowledge into discrete, rationalized, low-skill tasks, by abstracting actionable knowledge from the physical site of labor to centralized databases and global considerations, and/or by increasing managerial surveillance over workers (Braverman 1974; Zuboff 1988; Kallinikos 2007; Sewell 1998). Workplace information technologies facilitate the creation of digital accounts (Scott 2006). By converting work practices into ostensibly objective, morally neutral records of human action, information technologies legitimate certain types of knowledge and experience, while rendering others invisible and nonactionable (Bowker and Star 1999; Markovits 2001)—all to potentially detrimental effect on worker power.

The use of technological monitoring and data analytics as a means to discipline and control employees assumes many different guises, most commonly through governance strategies like measurement, classification, and ranking (Foucault 1977; 1980; Espeland and Stevens 1998; Sauder and Espeland 2009), generally relating to efficiency, productivity, and profitability. These tactics make work processes knowable to remote parties by operationalizing job performance as a set of calculable, commensurable metrics, and making the employee's actions both visible and (by implication) governable (Covaleski et al. 1998; Langfield-Smith 1997; Miller and O'Leary 1987; Stanton 2000; Townley 1993).

Information technology is particularly integral to managerial control practices when workers are dispersed in space, rather than directly observable. As industries expand their geographic reach, remote managers increasingly rely on information communication systems to control far-flung resources, including employee activities (Beniger 1986; Law 1986; Yates 1993). The need for coordinated, universalized information infrastructures can create challenges for local implementation when locally situated variation comes into conflict with the imperatives of standardization—as when the situated knowledge of workers "in the field" cannot be easily integrated into the formats required by information technology (IT) systems (Rolland and Monteiro 2002), or when such abstraction diminishes or decontextualizes what can be perceived through physical presence at remote worksites (Bailey et al. 2012; Jonsson, Holmström, and Lyytinen 2009). Distributed work situations thus pose special challenges for technologically mediated worker control, in that managers are both physically and conceptually distanced from field knowledge.

Yet even as these information flows flatten some contexts, information remains grounded in, and contingent upon, the social worlds in which it operates. Social relationships and structures affect the impacts of technologies, the manners in which they are interpreted by human actors, and the organizational uses to which data are put (Barley 1990; Thomas 1994; Kelley 1990; Orlikowski 1992; Boczkowski 2004; Wajcman 2013); information does not exist in a social vacuum. As such, technological abstraction of work processes is not the removal of context, but the redefinition of context to create new meanings and to implicate new social orders (Kallinikos 2007; cf. Esposito 2004).

TRUCKING AS A SITE OF INVESTIGATION

I investigate these dynamics via a deep ethnographic investigation of information practices in a unique setting: the U.S. long-haul trucking industry. Information and communication technologies are often vaunted for

making work less spatially contingent and thus more mobile (Forlano 2008; Nippert-Eng 1996), as digital information-sharing tools supplant the need for physical colocation. But trucking has never been colocated: it is inescapably and definitionally mobile.

This position makes truckers an ideal group through which to examine technological control in the present moment of distributed computing. Demographically, truckers are blue-collar laborers, not so dissimilar from the production workers whose work rapidly became rationalized, specialized, measured, and surveilled via technologically oriented management strategies (Zuboff 1988; Braverman 1974; Sewell and Wilkinson 1992; Townley 1993). But until very recently, truckers' spatial distribution meant that managers were unable to supervise their work processes directly. The fundamental mobility of truck-driving work, combined with the exigencies and contingencies inherent in highway travel—weather, accidents, and the like—has enabled truckers to retain more day-to-day occupational autonomy than many of their blue-collar brethren in nonmobile work settings. Trucking represents a unique setting for the investigation of organizational control, then, due to this combination of inherent spatial mobility with the blue-collar and intrinsically physical nature of trucking labor.

Culturally, truck drivers comprise a fiercely independent occupational group, and particularly resistant targets of social control. Though there is clearly a good deal of social variation within a profession comprised of more than 3 million people (Bureau of Labor Statistics 2011), truck driving maintains strong cultural traditions that are reflected in drivers' attitudes, behaviors, and professional identities. I describe these values here, as they bear on how organizational control is manifested within the industry.

Chief among the cultural traditions of trucking is a strong emphasis on independence and freedom. When I asked drivers about what attracted them to truck driving, many remarked that the autonomous nature of the job—the ability to make one's own day-to-day decisions about how to accomplish daily work tasks, to work hard without having a boss peering over one's shoulder, the "lone wolf" nature of the work—deeply appealed to them. Many drivers, of course, have worked in offices or factories before, or have worked under close supervision in the military or in agriculture. Some drivers told me they came to trucking after having conflicts with authority figures in these more traditional employment settings; as a trucker put it to Will (1992), "Truckers ain't organization people!"

Truckers' independence is thoroughly bound up with the rhetoric of the open road. There is romance in the way truck drivers describe the trip across the Rocky Mountains, or how the sunrise looks as they drive across the Great Plains. And many drivers talk with pride and satisfaction about how many corners of the United States they have seen in the course of their work—views far more majestic than the drab walls of a cubicle or the factory floor.

This emphasis on freedom and independence correlates with the gendered nature of the trucking workforce. The trucking population is at present about 95 percent male (Bureau of Labor Statistics 2011). Masculinity is a highly valued trait, and manifests itself in a number of ways. Some of my trucker informants are self-described "family men," with strongly professed Christian values and traditional notions of gender roles, who proudly show me pictures of children and grandchildren they are helping to provide for through their labor. For others, masculinity expresses itself as machismo—some truckers tell me boastfully about their varied sexual exploits as their work takes them across the country. This "cowboy" mentality is evidenced in classic trucker films, like *Smokey and the Bandit*, *Convoy*, and *White Line Fever*, which glorify disregard for (usually corrupt or inept) authority figures, and which feature strong, virile truckers as leading men. No matter how it is manifested behaviorally, being "manly" seems to be a particular point of pride for the truckers I meet, and bound up closely with the independence of the job.[1] Perhaps unsurprisingly, truckers' attitudes toward bureaucratic rules (both governmental and organizational) tend to be derisive. A strong libertarian streak runs through much of their political rhetoric, and truckers are generally contemptuous of what they see as unwarranted meddling in their private business.

Yet, despite their desire for independence, masculinity, and inclination to escape the strictures of conventional work environments, truckers encounter more day-to-day involvement with behavioral regulation than the average person. Some of these entanglements are based on firms' organizational rules and employment and/or leasing arrangements.[2] Others stem from the fact that truckers' daily work takes place largely on federal highways; it is on the system of public roads—with their speed limits and traffic controls, insurance and licensure requirements, and laws about seatbelt and cell phone use—that most of us feel the presence of behavioral rules most directly. Add to this the additional highway rules that apply specifically to truckers (designated "no-truck" routes, weight and height clearance limitations, fuel tax regimes) and the dozens of details of the trucker's workday regulated by the federal government—from strict licensure requirements, to required medical screenings, to the thorough vehicle inspection a driver must

perform each day—and the "open road" begins to appear much less open.[3]

The coupling of truckers' independent, masculine desire to escape the constraints of authority, along with their participation in an inherently mobile, blue-collar occupation marked by deep regulatory infrastructures, makes truckers an intriguing population to examine as targets of organizational control. My research here is informed by rich previous studies of trucking culture (Hamilton 2008; Will 1992; Ouellet 1994) and economy (Belzer 2000; Viscelli 2010); it updates this literature in light of the changing nature of trucking work, and focuses anew on the proliferation of information technologies to enact organizational control in the industry.

TECHNO-LEGAL REGULATION AND THE EOBR DEBATE

I turn now to describing systems of technological control to which truckers are subject. I focus on the electronic on-board recorder, or EOBR—a device whose presence in the industry is undergirded both by legal requirements and organizational directives.

A Brief History of Trucker Timekeeping

Since the 1930s, American long-haul truckers have been required by federal regulations to limit their work hours, in order to reduce accident risk caused by driver fatigue. Each year, truck crashes on America's highways kill 4,000 people and injure 100,000 more, at an annual cost of more than $40 billion (Truck Safety Coalition 2011). Though several factors contribute to crash risk, driver fatigue has been identified as having the strongest effect on accident rates (Lin, Jovanis, and Yang 1993). Though specific time limits have changed over the years, most drivers may legally drive no more than 11 hours per day, and can be on duty (a status that includes both driving and other functions, like fueling, loading/unloading, and performing vehicle inspections) no more than 14 hours per day. After the maximum on-duty time is reached, a 10-hour break is required; weekly limits also apply.[4] Drivers are required to keep a daily record of hours worked, typically via paper logbooks (Figures 1 and 2), which can be checked by law enforcement at weigh stations and periodically submitted to the driver's employer.

But for as long as these regulations have existed, truckers have fashioned techniques to evade them. Drivers face strong economic pressures to maximize their driving time (Belzer 2000; Viscelli 2010). Because they are typically paid on a per-mile basis, truckers have incentive to remain on the road even when exhausted; as truckers say, "If the wheel ain't turnin', you ain't earnin'!" Many go to great lengths, including drug abuse and other unhealthy practices, to remain awake. Trucking firms, too, may explicitly or implicitly pressure drivers to underreport their hours, in order to move goods at the pace of work demanded by the market. Paper logbooks are thus routinely falsified, so much so that they are often dismissively referred to as "coloring books" or "swindle sheets"; in one survey, only 16 percent of drivers reported that logbooks provided accurate depictions of drivers' activities (Belman and Monaco 2001). Law enforcement officers at weigh stations can be avoided with relative ease, particularly when drivers exchange information via CB radio as to whether a station is open or closed.[5]

The EOBR and the FMS

A proposed solution to this problem is the use of electronic monitoring devices, integrated into trucks themselves, that create a record of the hours the truck is driven. These devices largely automate the functions served by paper logs in efforts to curtail unsafe practices. Over the past 25 years, a series of rulemaking actions within the Department of Transportation has gradually integrated electronic monitoring requirements into the timekeeping rules. A regulation under current consideration would require all truckers to buy, install, and use EOBRs for timekeeping; the proposal is nearly certain to take effect in the next 2 to 3 years.

These regulatory actions have generated vigorous disagreement across the trucking industry and related sectors. Large trucking firms generally support the proposed mandate, as do insurance groups and public safety coalitions. But an EOBR mandate is ardently opposed by many—though not all—drivers. Truckers cite concerns about costs, efficacy, and (most crucially) whether mandated electronic monitoring violates drivers' privacy—for instance, by surveilling real-time location even when the truck is being used by a driver on his own time. Others contend that the systems can be used to facilitate harassment of drivers by dispatchers.

Though EOBRs are not yet legally mandatory, they are in use by roughly 30 to 50 percent of the industry now (as estimated by industry experts). Adoption is heavily skewed toward larger firms. This is due to the fact that many large trucking firms currently use electronic fleet management systems (FMSs) to track detailed information about their assets and employees, and FMSs are typically capable of recording and wirelessly transmitting many types of fine-grained data back to the "home office" in real time. Practically all FMSs on the market today include an hours-of-service module that monitors when the truck is being driven for regulatory compliance purposes (Figure 3). In practice, then, EOBRs are very commonly *modules bundled within* integrated fleet management systems, rather

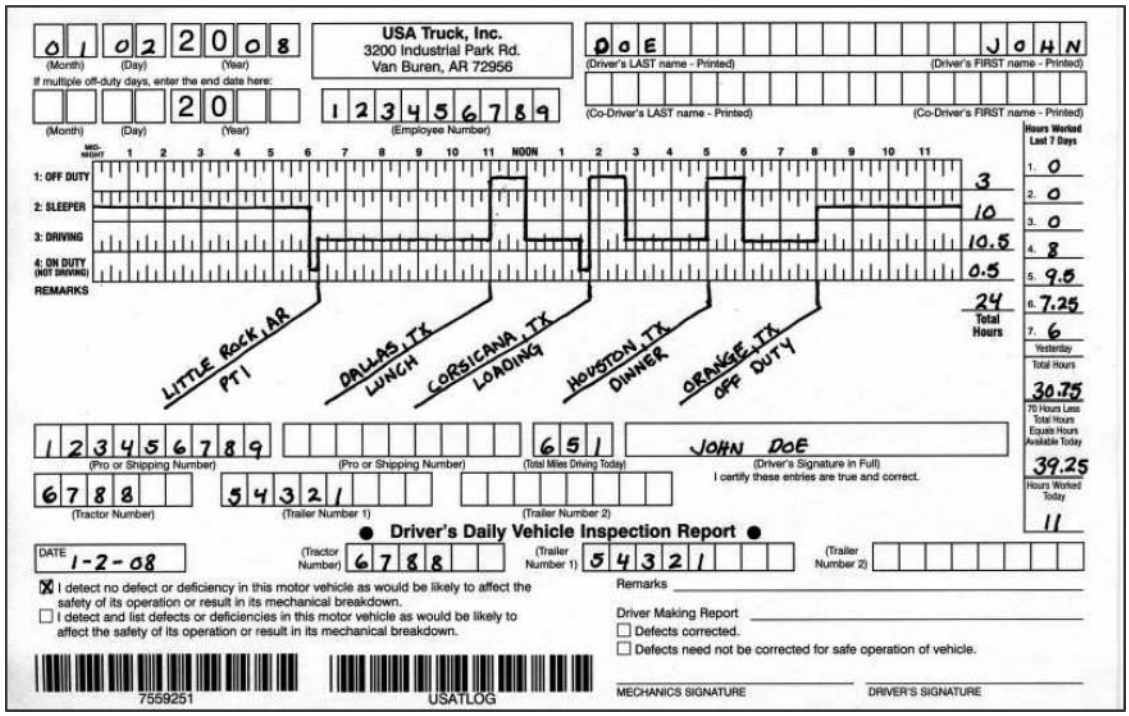

FIG. 1. Sample paper logbook entry page. The driver records his duty status by drawing a horizontal line on the appropriate row of the grid, and manually calculates the hours spent in each status at the end of the row (Image: http://commons.wikimedia.org/wiki/File:Truck_driver_log_book_%28example%29.JPG).

than discrete devices. It is these performance-monitoring features of the system that are most attractive and useful to large trucking firms, and which form the focus of much of this article. But the legal mandate remains an essential part of the story, by reducing the marginal expense firms incur for monitoring drivers' performance behaviors; since they will soon have to install EOBRs anyway, the purchase of the system can be treated as something of a sunk cost.

Importantly for trucking firms, fleet management systems are capable of monitoring many types of bundled performance data in addition to timekeeping. The range of information captured commonly includes a driver's fuel efficiency and idling time, speed, geolocation and geofencing (notifying a dispatcher if a truck has departed from a predetermined route or arrived at a terminal), lane departures and braking/acceleration patterns, cargo status (e.g., the temperature of a refrigerated trailer), and vehicle maintenance/diagnostic information. In addition to monitoring and transmitting this performance data, fleet management systems typically contain additional modules that provide services like routing and two-way messaging.

By current estimates, approximately 1 to 1.5 million EOBR units are in operation on the road today, and pervade close to half the trucking industry (heavily skewed toward trucks owned and/or managed by larger companies). Even in the absence of an EOBR mandate, market analysts estimate rapid further penetration over the next 5 years, with the number of units online expected to roughly double, particularly as devices' costs decline and capabilities increase over time. The mandate provides a business rationale for firms to monitor other

FIG. 2. A driver makes calculations for his paper-based logging system (Image: fieldwork).

driver behaviors not covered by the law: since they will be required to install EOBR hardware in their trucks anyway, the marginal expense of also monitoring (for instance) a driver's fuel efficiency is greatly reduced.[6]

DATA AND METHODS

My analysis here is based on empirical data gathered in the course of a larger multisited study of fleet management systems. Over a 2½-year period (from 2011 to late 2013), I examined the development and use of these technologies, and the trucking industry more generally, drawing from the perspectives of varied stakeholders. A multiple-viewpoint approach is essential to a thorough, nuanced understanding of any sociotechnical system (Gillespie 2007; Pinch and Bijker 1984; Howard 2002), particularly one that occurs against a landscape shaped by institutional logics. As such, I opted for an approach that provides a breadth of viewpoints via distributed, multisited fieldwork (Hine 2007). In total, research for this project took me to 11 states, and took place in a wide range of settings: from truck cabs to law offices, corporate offices to rest areas, conference centers to truck-stop bars.

I spoke with and observed truck drivers at a number of sites. I made multiple visits to large highway truck stops in two states, and spent 4 days among tens of thousands of truckers and trucking enthusiasts at the nation's largest trucking trade show. I interviewed drivers in break rooms at the firms where they worked, at the diners where they ate, and at other sites incidental to trucking work (e.g., trucking supply stores).

In addition, I conducted on-site field visits to four trucking firms, including both top-10 carriers and very small operations. Two of these firms used exclusively electronic logging systems; another was in the process of integrating it into their operations; and another used exclusively paper-based systems without electronic monitoring. In the course of my visits, I spoke with managers, safety directors, trip planners, dispatchers, trainers, and other personnel. At one large firm, I sat in the company's central "war room" and was permitted to listen in on dispatchers' real-time conversations with drivers.

I supplemented my firsthand observation of drivers and firms with several other data sources. I read hundreds of articles from trucker-oriented media sources, including magazines, newsletters, and radio programs. I kept tabs on drivers' online activities, including YouTube channels and active bulletin-board-based communities on which drivers shared information, opinions, and complaints. I read hundreds of comments submitted by drivers and other interested parties to federal agencies in the course of EOBR-related rulemakings.

To understand the technological aspects of fleet management systems, I attended fleet management conferences and seminars, a 3-day trucking technology summit, and several interactive online training classes presented by system vendors for trucking companies. I spoke with trainers, account managers, and consultants to learn about the capabilities and challenges of deploying monitoring technology within trucking firms. I also reviewed a wide range of relevant industry literature, including policy whitepapers, engineering reports, training materials, product manuals, and marketing literature dating back to the 1970s.

In the course of this fieldwork, I met and talked with dozens of drivers, technology firm representatives, regulators, and other industry personnel. I conducted, in person and via telephone, 81 interviews with individuals I met through direct fieldwork or via referral from prior informants. My interview subjects included drivers, trucking firm representatives, dispatchers, trip planners, system vendors and trainers, lobbyists, lawyers, fleet managers, insurers, inspectors, and trucking historians. These interviews were audio-recorded (and later transcribed) when possible, if the research participant consented; when interviews were not recorded, I kept detailed interview notes. I took a grounded theoretical approach to interpretation of the data: I developed an inductive coding regime, which was revised as data collection and analysis proceeded (Charmaz 2006).

ELECTRONIC MONITORING AND INFORMATION FLOWS

Fleet management systems reorient organizational information flows across three closely related, yet analytically separable, dimensions. In this section, I describe these shifts.

Aggregation

When fleet management systems are used to monitor truck drivers' work routines, aggregated information comes to supplant local and biophysical self-knowledge in terms of organizational value. Traditionally, truckers' value and a good deal of their occupational pride arises directly from their knowledge, often gleaned from years of experience, of the daily "ins and outs" of driving a truck—from how trucking equipment works and how to fix it quickly when repairs are needed, to local conditions that affect work routines (what roads are closed, what time of day traffic is the most onerous in various locations), to routing information (how many miles it takes to get from Omaha to San Francisco, and the "best" way to get there depending on weather conditions). Truckers—especially "old hands" (Stratford et al. 2000) with millions of driving miles under their belts, who have

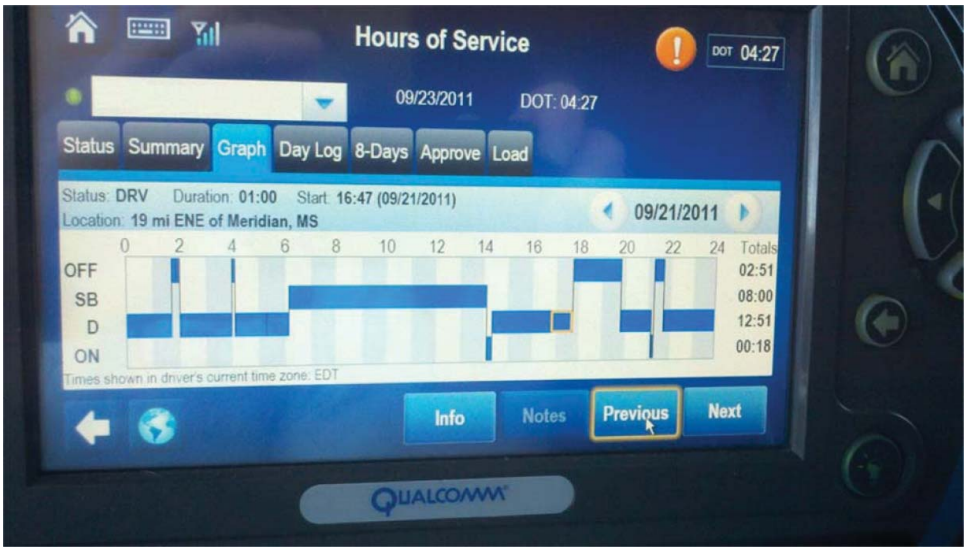

FIG. 3. Hours-of-service module displayed on a Qualcomm fleet management system (Image: http://commons.wikimedia.org/wiki/File:Qualcomm_EOBR_model_MCP110_September_2011.png).

been on the road for years or even decades—take pride in sharing this knowledge over CB radio, and show considerable pleasure in regaling one another (as well as the occasional researcher) with detailed stories of how such knowledge has benefited them in some manner or another on the road, and in describing their knowledge of the best routes without needing to use technological "crutches," like global positioning systems (GPS), as support. Consider the following exchange I had with one driver about how to get from Oregon to Indiana:

> Q: So you don't use GPS though?
> A: GPS? No. Honey, I've been driving for twenty-nine years, I've been all over the United States, I don't need a GPS. I don't even need a map.
> Q: You don't use a map?
> A: [laughing] No.
> Q: Really?
> A: Hell, no. I could drive—where do you want to go?
> Q: West Lafayette, Indiana. [. . .]
> A: Go around Ontario, Oregon, over to Pocatello. Go south on Pocatello, go to McCammon, that's 30, it runs—McCammon runs over to 80, I-80, that'll come out by Little America, take Little America—or the 80, excuse me—run that over to Chicago, right? Get through Chicago, now from there it's up to you which way you want to go. [. . .] You'd have to go south on 65, down towards Indianapolis. [. . .]
> Q:So how do you learn all this [about different routes]?
> A: Honey, driving them.

Exchanges like this were common in my interactions with truckers, as were "war stories" about drivers' experiences navigating particularly knotty routes or demanding timetables over the years. Truckers also described ways in which their own knowledge trumped the ineptitude of other human beings, like dispatchers or inspectors, or the shortcomings of technologies themselves, like faulty routing equipment. "Road knowledge" gleaned from years of experience serves as a clear source of value and professional identity for these workers.

Pride in accumulated "road knowledge" extends, too, to bodily self-knowledge about how fatigued a truck driver feels. Numerous drivers articulated strong resistance to being told what their own individual biophysical limits are. As two drivers put it in regulatory comments:

> A computer does not know when we are tired, [f]atigued, or anything else. Any piece of electronics that is not directly hooked up to my body cannot tell me this. . . . I am also a professional [and] I do not need an [EOBR] telling me when to stop driving . . . I am also a grown man and have been on my own for many many years making responsible decisions!

> I'm not going to work under conditions where I'm treated like a child, a child who doesn't have enough [sense] to know when to go to bed and when to get up; or when to stop and rest while rush hour traffic clears and then proceed when rested and safer.

For many drivers, then, professionalism and occupational pride are deeply entwined with knowledge of biophysical and local conditions, which have long been of primary value in the effective completion of their work tasks. But the value of these forms of knowledge is displaced by fleet management systems that provide services such as automatic routing and geolocation, remote diagnostics, geofencing, hours-of-service monitoring, and tracking of other fine-grained indicators like fuel use and hard braking incidents. These modules accumulate and summarize information in order to create detailed performance metrics for drivers (Figure 4). Comparisons can be easily made for different periods of time, both within and across drivers, across groups of drivers (as defined by

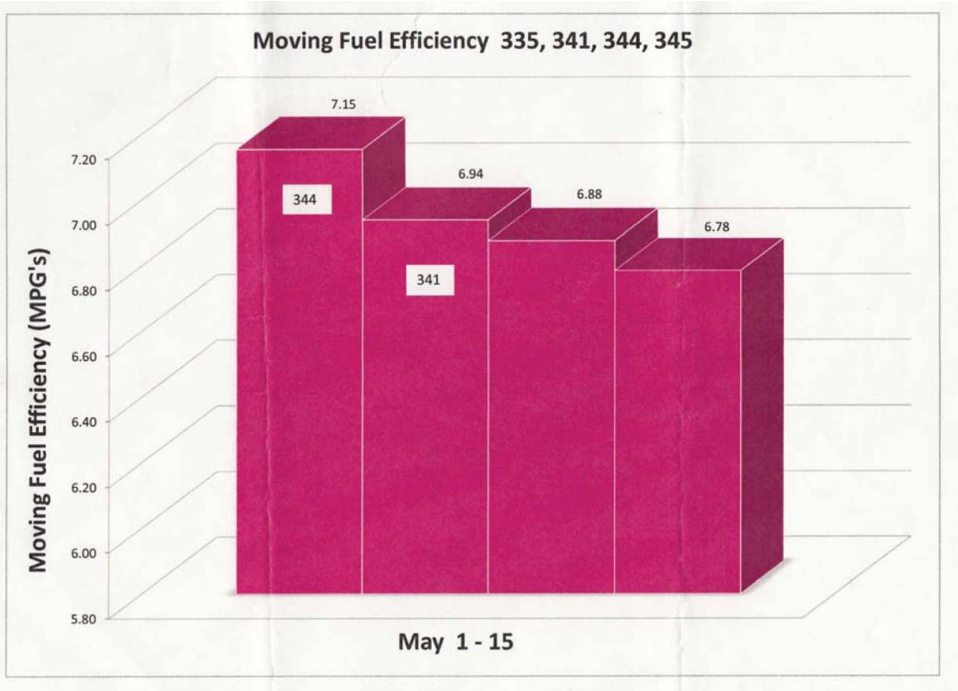

FIG. 4. A driver analytics comparison chart, posted in a trucking company common area. The chart uses drivers' identification numbers rather than names, and compares their fuel efficiency (Image: fieldwork).

back-office managers on any basis: managers can compare customizable driver groups based on type of equipment, type of haul, driver experience level, or any other imaginable axis of variation), or between a company's fleets and industry averages. This aggregated information, summarized in quantifiable and easily comparable metrics, becomes a highly valued management tool produced by means of the sociotechnical system, one that large trucking companies spend millions of dollars to acquire, install, and manage.

Exclusivity

A second dimension of change concerns who possesses actionable information. When monitoring systems are used, truckers are no longer the sole holders of relevant information, as monitoring systems distribute it to remote dispatchers. Truckers themselves still possess knowledge of their work activities, but they are no longer its exclusive possessors.

Traditionally, a driver (even an employee driver of a trucking firm) is considered the "captain of his ship": Like captains of other transportation vessels, the trucker holds the ultimate authority to stop driving if, by his own judgment, he is too fatigued to drive, or if local weather or road conditions make continued travel unsafe. Drivers are accorded a high degree of autonomy in deciding when and how to conduct their work, which is closely bound up with the emphasis on local and biophysical knowledge. Indeed, many drivers report that this decision-making independence is what initially attracted them to the profession, and it serves as a strong source of professional pride.

Yet when fleet management systems are used to transmit information from trucks to dispatchers at an employer's home office, employers have much more information at their disposal—both aggregated data about drivers' performance, as described, and additional information that imputes to the dispatcher knowledge about the driver's internal and local conditions. Under the "ship captain" model, a driver may declare authoritatively that he is too fatigued to drive; however, when the driver's hours of service are monitored by a fleet management system, a dispatcher may respond to the effect that "I know you aren't (or shouldn't be) too tired, because I can see that you've only been on duty for five hours." Similarly, a driver may state that a road is currently impassable due to weather conditions; his dispatcher may respond that "I know the weather is not too bad for you to continue driving down I-80, because I see that I have four other trucks on that road now." (Each of these examples was reported to me as having occurred.)

To illustrate, in one exchange that received attention in industry media (Tanner 2013), a driver received the

following string of messages while on a legally mandated sleep break (emphases mine):

12:57 pm	Firm:	Are you headed to delivery?
1:02 pm	Firm:	Please call.
2:33 pm	Firm:	What is your ETA to delivery?
2:34 pm	Firm:	Need you to start rolling.
2:35 pm	Firm:	Why have you not called me back?
3:25 pm	Driver:	I can't talk and sleep at the same time.
3:37 pm	Firm:	Why aren't you rolling? *You have hours* and are going to service fail this load.
3:44 pm	Firm:	*You have hours* now and the ability to roll—that is a failure when you are sitting and refusing to roll to the customer.
3:51 pm	Firm:	Please go in and deliver. We need to service our customers. Please start rolling. They will receive you up to 11:30. Please do not be late.
4:14 pm	Driver:	Bad storm. Can't roll now.
4:34 pm	Firm:	Weather Channel is showing small rain shower *in your area*, 1–2 inches of rain and 10 mph winds ???

Here, the dispatcher repeatedly invokes his knowledge of the driver's status and location ("you have hours"; "in your area"), and challenges the driver's local assessment of conditions with his own remotely retrieved data (dispatchers commonly plug a driver's GPS coordinates into weather or map websites).

Of course, the fact that the system makes it possible for dispatchers to override drivers' judgment does not mean that they always do. Based on my observations in trucking firms and what drivers reported about their experiences, there is significant variation in the degree to which firms question drivers' judgment based on the data at their disposal, particularly when safety is at stake. However, it is also likely that the fact that the data are being collected—the reality of which drivers are very much aware—prevents drivers from making claims that the data would not support: it is difficult for a driver to say he is out of driving hours in order to avoid an undesirable load assignment, because he knows that those data are readily accessible by dispatchers and trip planners.

Interestingly, one trucking firm purposefully delinks hours-of-service data from the software used by their dispatchers, so that "drivers have to tell us how they are managing their hours and the next time they will be available for dispatch. . . . Bottom line is our drivers are the captain of their ship. They tell us what they can do, not the EOBR data." This use underscores the heterodox use of any technical system and the paramount importance of organizational context in determining how such systems impact social and economic relationships (Barley 1986; Orlikowski 1992). However, this situation was unique in my research; in most cases, it appears that dispatchers are given ready access to information about drivers' location and legally available hours, in order for these data streams to be utilized as managerial tools.

Temporality

Third, the systems enable a temporal shift in information flows, as information is distributed in real time. Under current rules, a trucker is officially required to keep his paper logs up-to-date at all times by updating the log each time his duty status changes (e.g., when he begins driving for the day, stops for lunch, or arrives at a shipper's terminal). But in practice, a significant lag exists between a driver actually recording information on his paper log and a dispatcher having access to information about hours worked. A driver using paper logs is required by federal regulations[7] to submit his paper log to his employer within 13 days of its completion; it is common practice for drivers to submit their paper logs at the conclusion of a trip, and for drivers to be well behind on their recordkeeping during a haul. This lag time gives the driver ample opportunity to make adjustments to the form before submitting it to his employer, which therefore gives him "wiggle room" to appear compliant in post facto records, whether or not his actual driving behavior was in fact actually in line with legal rules (which it frequently is not).

One driver, Fred, described to me how the paper-based system afforded him flexibility:

> Q: So, did you have to keep track of your time before you got the Qualcomm?
> A: Yeah.
> Q: How'd you do it?
> A: With a logbook. But in a logbook . . . it works pretty well, because you can chisel parts off here, and parts off there, and you make the whole trip fit perfectly.
> Q: So, when you say you're chiseling, does that mean that you're twisting it a little?
> A: Well, you do a fifteen-minute pre-trip [inspection]; then you get caught in traffic for, like, an hour. You can give up a meal break, you can give up an equipment check, and that covers that hour.
> Q: So, you just fudge it a little bit.
> A: That's it.

When Fred refers to "giv[ing] up" a meal break and equipment check, he means that he would record a rest break and equipment inspection in his paper logbook, but not actually take the time to perform these activities. Rest breaks and equipment inspections are legally required, and it is thus in his interest to report having completed them; the time it takes a driver to complete them counts against his 14-hour daily work limit but not the crucial 11-hour daily driving limit. By "chisel[ing]" these activities off, Fred uses the saved time for

additional driving. In this way, Fred would gain an extra hour of driving time without recording it on his log.

Under the paper logbook system, then, it is common for a driver's timekeeping records to be well behind, and to be reconstructed after the fact to portray compliance regardless of actual behavior. This lag time thus becomes a source of power for a driver like Fred to complete his work tasks more or less as he sees fit, without regard for minute-by-minute accounting to his employer or other parties. (In this respect, the arrangement bears resemblance to the ship captains of the East India Company, as documented by Erikson and Bearman [2006], who show that the spatial and temporal distance between captains' actions and reporting to central offices facilitated captains' regular malfeasance.)

But when fleet management systems are used to track a driver's hours of service, this information is transmitted in real time back to employers. Information about where a driver is, whether he is moving and how quickly, and how long he has been on the road or on a break is constantly updated. Using a "breadcrumb" map view, dispatchers can watch all of a fleet's truck drivers move across the country in real time, and can see all drivers' to-the-minute drive time data in an orderly spreadsheet as it happens. The real-time nature of this information distribution means dispatchers can see violations as they happen, and can even anticipate violations before they occur. Some systems' dispatcher portals turn a driver's data cell red when he is within a few minutes of a violation, visually flagging the driver so that a dispatcher can respond immediately by communicating with and directing him as to his next course of action. Drivers accordingly have less decision-making autonomy to determine how to handle the situation if a violation is about to occur. Moreover, because drivers no longer have 13 days to strategically "correct" a log, they can be much more readily penalized by their employers for violations.

The temporal shift also enables putative harassment of drivers by employers. Even when drivers are off-duty, employers can see where they are, and can contact them using systems' communication functions—which sometimes lack a "mute" function for drivers to silence employer attempts at communication, even during sleep breaks. One driver reported that other drivers in his fleet took technical steps like removing fuses to prevent being contacted during off-duty hours, but that this was a risky, fireable offense. If, for example, a driver has not left a rest stop as soon as it becomes legal for him to do so, a dispatcher may call and pressure the driver as to why he is not on the road yet (as in the "Weather Channel" exchange discussed in the previous section, in which the dispatcher sent repeated pleas to a sleeping driver to "roll" at 1-minute intervals). In one industry survey, 68 percent of drivers reported being told by firms to drive longer, and 29 percent reported being awakened to be given these instructions (Jones 2012).

INFORMATION AND DYNAMICS OF SOCIOTECHNICAL CONTROL

The three-dimensional shift in organizational information flows facilitates two disparate effects, which operate together to enact corporate control over drivers. The first effect involves the abstraction of truckers' labor from its local and biophysical contexts, and its translation into disunited, disembodied metrics. The second involves the resocialization of this information via its strategic deployment into truckers' relationships with their coworkers and families.

Abstraction

Fleet management systems restructure organizational information flows by reconstituting truckers' embodied work as a set of divisible, rationalized data points, presented in an apparently neutral format. These data are divorced from the context of road conditions, the contingencies of weather and shippers' schedules, and other individuated circumstances. This abstraction has two effects on drivers' occupational power: In addition to facilitating quantitative performance evaluation when such data are recombined as driver scorecards, electronic monitoring also gives dispatchers an evidentiary basis on which to challenge drivers' assessments of local and biophysical conditions. As described, a dispatcher can consider a trucker's declaration that a road is impassable in the context of what he now knows about how other drivers are performing under the same conditions, or can consult a driver's historic hours-of-service records or fuel-usage scores in appraising the reliability of his statements about extenuating circumstances that lead to a violation of safety regulations or company policy. The provision of additional contextual information via the electronic system equips the company dispatcher to manage his or her workforce and evaluate employee performance with less dependence on a driver's claims about conditions that the dispatcher cannot directly observe.

Many drivers read this use of data as confrontational and evincing a lack of trust. As one driver put it: "If you can't trust me to go out there and be safe and honest, then take me out of the game and put somebody in there that you think can. Either that or put a robot in the truck!" Others feel that managerial reliance on abstracted data is utterly incompatible with their highly contingent, unpredictable work:

Q: So, what is it that you don't like about the [electronic monitor]?
A: There are things that happen in the life of trucking that can't be overcome.
Q: Like what?
A: Accidents on the road, breakdowns, flat tires—anything that will slow you up. From Point A to Point B it's, say, 200 miles. You've got 4 hours to get there. That's 50 miles an hour, that's a good average for a truck. If anything happens between that—a wreck, anything where you're just sitting in the middle of the road wasting your goddamn time—excuse me, your time—you can't make that. And then they want to know why not.
Q: Who's "they?" The company?
A: Yeah. And the customer especially. Well, I've been driving—like I said, I've been driving truck 42 years. I'm not in the habit of explaining myself. Having me to explain myself is really an insult.
Q: So, how does the computer affect that?
A: Well, if I've got to sit there for 45 minutes or an hour, I'm down to 3 hours delivery time. It don't give a damn if I'm sitting there in a wreck.
Q: The computer, you mean?
A: No, it don't know nothing about that.

This sense extends from local to biophysical conditions as well, as another driver put it: "You, as a professional, you know when your body is tired. You know when your mind is fatigued. You know when you need to stop and rest. That dispatcher doesn't know. And by God, that electronic device certainly does not know."

Resocialization

Another sociotechnical pathway toward organizational control of truckers is firms' deployment of electronically derived data into truckers' social lives, both within and outside of the fleet, in an effort to foster social pressure toward conformity with organizational goals.

It is worth noting that it is not at all unprecedented for truckers to share information within their professional community. Drivers frequently share information among themselves on CB radios, on online forums, in informal conversations at truck stops, and in other venues. These exchanges build community and social solidarity among drivers, support their occupational identities, and encourage the formation of professional pride. The kinds of knowledge drivers share sometimes include advice about how to circumvent rules effectively (e.g., in order to help other drivers avoid open weigh stations and the inspections that occur there, drivers will commonly radio to one another that "the chicken coop is clean" [Brown 1976]).

Unlike these other technologically assisted knowledge-sharing activities, fleet management systems enable information about truckers' activities to be shared without their direct agency or consent in order to create competition among workers. Many fleet managers post or distribute rankings based on drivers' "scorecards," which the systems make technically very easy to produce. Scorecards display driver safety records, hours of service, or other performance indicators that align with organizational goals; fuel efficiency is a very popular metric, given the high present price of fuel and its significant impact on trucking companies' financial bottom lines. The ability to easily aggregate, specify, parse, and compare these data across multiple drivers is one of the chief advantages of such systems, particularly for larger companies.

By posting performance data where drivers can see them, companies create social pressure for comparatively underperforming drivers to improve and compete (Mello and Hunt 2009). A system trainer (who advises firms about how to adopt and use fleet management systems) described to me how such displays are utilized to motivate the least efficient drivers in a fleet:

> [Companies] just put the list up and it would say, Driver A, his MPGs are 8.3, and Driver B is 8.2, and Driver C is 7.6, and Driver D is 6.2. And you post it up. Well, if you do that, what is it going to tell you? I don't want to be the one at the bottom, and next week the butt of the jokes. So I [the company] might not even say it, I just show it. And now that guy tries to do a little bit better. [. . .] So it all depends on how you want to incentivize your drivers [. . .] some of it is just posting it up on the wall and letting them look at it.

This strategy, then, depends on drivers feeling interpersonally shamed by their coworkers ("the butt of the jokes") as a result of inefficient performance. Many firms go further by directly tying small financial incentives to the rankings produced by fleet management systems. These incentives often cost firms very little, but coupled with the pride (or embarrassment) of one's comparative ranking, were considered effective tools for aligning the goals of firms and employees:

> [You're] a fuel company, let's say, and you want your drivers to improve. And if they get a score of let's say 90 or above, you give them a 25-dollar gas card from your company. Well, not only are you giving them 25 bucks, they think it's great, but it's not costing you 25 because they're buying your gas! [. . .] We had customers that did that all the time. And it wasn't just gas, but other things, because we had customers that did food [. . .] and the drivers could go eat at the restaurants that they service . . . so it's not really costing you 25 bucks. It is, but it isn't. And drivers appreciate it and they start to do things a little bit better. You know, and it doesn't have to be a lot anyway. So that's why a lot of people do it that way.

These incentive alignments, though often substantively small for companies, can provide powerful symbolic motivations for efficient employee performance. Incentivizing employees through intra-workforce competition is not new (Burawoy 1979), yet the degree to which these programs comprise a fundamental element of the sociotechnical system is striking. Technical

trainers (who work for the technology vendor) counsel trucking firms on how to integrate such schemes into their use of the technology, often under the rationale of "culture change," just as they provide advice on the technical workings of the FMS. Marketing materials and vendor-issued whitepapers stress the importance of rolling out incentive programs along with the installation of the systems, advising managers that "barriers to adopting telematics solutions are usually about how people accept change. . . . It is possible to drive improved business results using people's natural inclination to be competitive."

Firms' efforts to resocialize electronically derived data do not end within the company. Firms also invoke social pressures in drivers' own nontrucking communities as well, particularly among their families. Incentives like awards ceremonies and banquets, to which drivers' families are invited, are common strategies. But involvement can be even more directed, as well: For instance, one firm sends small bonus checks for the highest performing drivers (as determined by driver scorecard data) to the drivers' wives, in the wives' names. The idea behind the program, as it was described to me, is that wives come to expect the checks periodically (as "a profit-sharing arrangement," in recognition of a wife's familial support of her trucker husband); wives are expected to create pressure for their husbands to continue meeting the company's organizational performance benchmarks.[8] Recalling the strong "family man" mentality many truckers exhibit, it is perhaps unsurprising that firms' control techniques capitalize on this normative orientation toward economic provision for one's family.

CONCLUSION

Electronic monitoring practices are simultaneously embedded in a range of complex contexts. They serve legal and organizational aims; they centralize and redistribute operational information; they isolate data from surrounding circumstances while creating new referential frames.

The truckers' case builds on previous research in demonstrating the difficulties that can emerge when highly rationalized information systems confront local imperatives in distributed work settings (Rolland and Monteiro 2002). But the case also demonstrates that rationalization can be an incomplete explanation of the mechanisms through which information systems reconfigure organizational information flows. Fleet management systems, as used in trucking firms, provide multiple and surprising pathways toward managerial control over workers. The systems provide "hard" evidence, in the form of aggregated referential information (Kallinikos 1999), which forms a basis for challenging drivers' accounts of local and biophysical conditions. In addition, these abstracted data serve as criteria for the evaluation of truckers' performance with respect to one another, in terms of newly quantifiable metrics (Townley 1993). This strategy is given extra "teeth" when such data are strategically reembedded in truckers' social networks of coworkers and families to compel compliance with organizational objectives.

Each of these strategies depends on rendering drivers' work processes—previously self-contained and immune from immediate oversight, by virtue of their spatial circulation—newly visible (Zuboff 1988). Truckers have long depended on their mobile invisibility to retain a degree of autonomy unmatched in other blue-collar jobs. But this seems certain to change in an era of spatially distributed organizational surveillance. By illustrating the specific mechanisms through which monitoring can engender managerial control, the trucking case reveals new, multifaceted pathways to the entrenchment of power in modern organizations.

NOTES

1. My categorization of truckers into "cowboys" and "family men" is congruent with the Stratford et al. (2000) study of HIV risk factors among long-haul truckers, in which he and his colleagues characterize their subjects as risk-taking "highway cowboys," more moderate "old hands," and "Christian truckers/old married men," who exhibit the least risky behaviors and have the most stable family relationships. Consider also Hamilton's (2008, 199) characterization of popular trucking culture in the 1970s viewing "working-class manhood as a constant negotiation between the poles of promiscuity and fidelity."

2. Roughly speaking, there are two types of employment arrangements in trucking. A driver may be a traditional employee for a firm or private fleet (in which he drives a truck that the company owns), or may be an independent owner-operator driving his own truck. Owner-operators can compete for individual hauls, often via brokers or electronic "load boards," or may be leased to a carrier for a period of time. My analysis here, being focused on information flows and worker power within trucking firms, is primarily focused on truck drivers who work as employees of such firms; these drivers are much more commonly supervised through fleet management systems than are independent drivers.

3. Compare Hamilton's (2008) characterization of the "dense web of weigh stations, ports of entry, reams of paperwork, layers of taxation, and contradictory regulations" with which truckers must contend. Notably, the degree of "social" regulation, governing truckers' working conditions in the name of safety, has increased markedly since the economic deregulation of the late 1970s and early 1980s (Belzer 2000).

4. Current hours-of-service rules are listed in the Code of Federal Regulations, 49 C.F.R. § 395.3.

5. References in trucker popular culture suggest the ubiquity of these violations and the extent to which they are taken seriously by truckers. Consider the 1963 trucker anthem "Six Days on the Road," written by Carl Montgomery and Earl Green and popularized by Dave Dudley ("I.C.C. is checking on down the line / I'm a little over weight, my logbook's way behind / But nothing bothers me tonight / I can dodge all the scales all right / Six days on the road and I'm gonna make it home

tonight") or the 1975 hit "Convoy" by C.W. McCall ("We tore up all of our swindle sheets / and left 'em settin' on the scales").

6. It should be noted that firms face contradictory economic incentives regarding electronic hours-of-service recording: While firms don't want their fatigued employees to have accidents, they do want them to transport goods quickly. For large firms especially, the potential loss of employee productivity can be economically offset by safety benefits, reduced litigation risk, and savings on insurance premiums and internal auditing costs—as well as enhancements to efficiency supported by performance monitoring. In some cases, firms may instruct drivers about how to exploit the technical limitations of the monitor to evade the timekeeping regulations without being caught (for instance, by mislogging time doing nondriving work, like vehicle inspection, as sleep time).

7. 49 C.F.R. § 395.8(i).

8. By embroiling families in these managerial control regimes, monitoring-related incentive programs bear some resemblance to the involvement of wives and girlfriends as supports for state-based surveillance systems detailed in Goffman (2014).

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