Accountability in the Blue-Collar Data-Driven Workplace

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ABSTRACT
This paper examines how mobile technology impacts employee accountability in the blue-collar data-driven workplace. We conducted an observation-based qualitative study of how electricians in an electrical company interact with data related to their work accountability, which comprises the information employees feel is reasonable to share and document about their work. The electricians we studied capture data both manually, recording the hours spent on a particular task, and automatically, as their mobile devices regularly track data such as location. First, our results demonstrate how work accountability manifests for employees' manual labor work that has become data-driven. We show how employees work through moments of transparency, privacy, and accountability using data focused on location, identification and time. Second, we demonstrate how this data production is interdependent with employees' beliefs about what is a reasonable level of detail and transparency to provide about their work. Lastly, we articulate specific design implications related to work accountability.

Author Keywords
Data-driven Work; Tracking; Accountability; Blue-collar Work; Accounting Devices; Technology in the Workplace; Transparence, Privacy, Mobile Devices; Datafication.

ACM Classification Keywords
H.4.m. Information systems application (*e.g.*, HCI):

INTRODUCTION
Data-driven technologies have entered almost every aspect of our everyday, professional, and private lives [2, 3, 6, 11, 14, 21, 25, 29, 32]. Even occupations that were once considered largely manual labor (*e.g.*, electricians, plumbers, construction work, and facility managers) increasingly require computing skills, as routine tasks become both data-driven and analytic [28]. For example, construction workers encounter new data-driven tools for work coordination, such as mobile devices for more detailed planning and the interactive use of building models at construction sites [20]. And, rather than manually check thermometers, facility managers can interpret large data sets on a building's humidity and temperature collected from sensors [6].

This paper explores mobile technology's diffusion into manual, blue-collar work and the evolving possibilities and responsibilities such technological diffusion creates [22]. Here, we reflect on the consequences of increasing data production in all spheres of life – what van Dijck has referred to as 'dataism,' in which we increasingly trust personal information (even as an employee) to corporate platforms [33]. We revisit work accountability [4, 9, 25] as a key concern for the design of collaborative work technologies. Employees (in this case electricians) are increasingly responsible for generating data as part of their day-to-day work (*e.g.*, tracking work hours; tracking client interactions; demonstrating project progress). Given that new work tracking tools appear to enable more and more types of work documentation, the opportunity arises to understand work accountability, class, and labor as they develop in practice. We define *work accountability* as: the information employees deem reasonable to share and document about their work practices, progress, and outcomes; with whom employees want to share that information; and under what circumstances that information protects employees or makes them vulnerable to other stakeholders.

The paper reports an observation-based qualitative study of electricians' data work in a mid-sized electrical company. We studied how electricians' day-to-day work now includes producing data, as they are required to use a mobile and desktop-based customer relations management (CRM) system. These employees document in the CRM system the materials they use for a certain task (*e.g.*, a ground electricity switch), making the details of how the task was carried out

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traceable to the company. Thus, by requiring electricians on site to complete these new data-driven tasks, the company demonstrates accountability to clients and legal authorities. While electricians have accounted for safety-related issues for years (certain types of electrical work can only be carried out with proper authorization), with the CRM system an electrician's work now also includes data-driven cognitive and analytic work. For example, a certain type of material may be required per legal rules and regulation (for this case the particular type of switch), but the CRM system makes compliance difficult, because it only allows a search query that includes the material manufacturer and the exact search phrase under which it is registered. To avoid penalties, electricians may instead make their work traceable through workarounds (*e.g.*, browsing for a similar product's European Article Numbers (EAN) on the web that CRM will accept). In this way, electricians can add an EAN number to the system, even if it is not entirely correct (*e.g.*, a different retailor, but a similar product to the one used). Thus, failure to comply with CRM requests for information result in management surveillance actions (*e.g.* extended scrutiny on data entered by electricians).

The CRM system becomes an accounting device when it provides information to overview work process documentation for multiple stakeholders [9]. In our case, the CRM mainly collects data to track and analyze customer interactions. For electricians, such data collection includes billable work hours, materials used, and location (GPS coordinates). In contrast to prior work on accounting devices, we note how the observed CRM system integrates location tracking (GPS), thereby providing new insight into how to fill the gap between work and its representation [9]. Specifically, we demonstrate that data in the CRM becomes transformational by shifting more responsibility on employees through the banal, but nonetheless extensive use of work documentation. Further, by drawing on recent work in HCI that addresses the relationship between class, labor and design [8, 16, 21, 25], we contribute to an understanding of blue-collar work experiences with the accountability and tracking processes of work-related computing systems.

Work process documentation within the CRM can align with or against employees' interests. Employees may be *coerced* into being highly surveilled and visible to others in their work [27]. For example, they might be pressured to disclose data about their work [14], even when it is not legally required, to avoid employer-imposed penalties. Work tracking is always situated by where and when data is shared. Such data become part of a boundary-regulating process in terms of what details about their work that employees are comfortable sharing and disclosing [24]. When it comes to tracking, boundaries for disclosure and transparency are not fixed, but change over time [2, 14, 24]. Boundary regulation is not a static act [2], and also with tracking of work it is negotiated when and how it is deemed reasonable by employees that data can be used for a certain purpose. A key aspect of studying accountability and tracking in the blue-collar workplace therefore concerns how employees negotiate reasonable levels of detail to make visible, and their conditions for such disclosures. Thus, our research question is: *How do employees negotiate work documentation on a day-to-day basis, and how is the level of tracking adjusted accordingly?*

We found that when electricians understand the mechanisms of how and when their manual data entries are combined with automatically-generated data – they are able to effectively negotiate work accountability (*e.g.*, their personal responsibility in the case of a customer complaint). In this way, we demonstrate how work accountability manifests for manual labor employees' work that has become data-driven.

The company benefits overall when electricians know how to maneuver within the CRM system: by accurately reporting and tracking work-related interactions, practices, and services, such employee skills help the company create and foster productive relationships with their customers and legal authorities. Support and training is equally important to provide both management and employees with the necessary opportunities for the reflection needed to transition to data-driven work, we found.

The paper is structured as follows: First, we review prior research in HCI and related fields, specifically focusing on accountability, tracking, and skill. Next, we present our method and case study – a mid-sized construction firm specializing in electrical work. Third, we analyze the electrician's data work to show how the diffusion of mobile technology into the workplace affects employees' abilities to negotiate accountability in their daily work. Finally, we offer design implications for work accountability.

ACCOUNTABILITY, TRACKING, ACCESS, AND SKILL

HCI has a long history of focusing on the relationship between technology, data, and accountability [3, 8, 9, 11, 19, 21, 25, 29, 32]. One aspect of how accountability is pursued in CRM is through location-based data. Early on, designing for accountability by using location-based tracking was perceived as rather 'unusual,' as this technology was tested on sex offenders [32]. Troshynski, Lee, and Dourish's study of sex offender tracking effectively illustrates that how we render ourselves accountable to a certain social group is dependent upon our relationship with them *(ibid)*. Their study illustrates that accountability concerns both absence and presence; for example, when sex offenders decide to change their routes to avoid certain spaces or people, they create data about where they both have and have not been. In design, the kinds of representations built into workflow systems create assumptions about to whom and under what conditions accountability ought to be encouraged and enforced [4, 9, 32].

Today, location-based tracking has become a mainstream technology integrated into work representations of, for example, hospital orderlies [3, 29]. Tracking hospital practitioners is also tested in the setting of architectural design of hospitals to create better work representations [21]. Møller *et al*. point out how hospital practitioners consider location-based tracking as a negotiation of the amount of reasonable extra work that they should accept. In this case, tracking is obstructed if the purpose of tracking is not considered reasonably purposeful by those tracked *(ibid)*. Thus, "to construe workflows based upon data tracking, balancing the seamless boundary of privacy in work and surveillance in cooperation with the practitioners is of critical importance. Without support from the practitioners, data quality is at risk, and the resulting workflows might turn out flawed" [21 p. 2153].

The use of data tracking in work is often characterized along a spectrum ranging from caring to coercive [27]. Thus, a second crucial aspect for examining work and tracking accountability is understanding when and under what conditions location-based data becomes surveillance from employees' perspective. According to Sewell and Barker [27], the purpose of coercive surveillance is to pressure employees into doing something that they otherwise would not have done, because it may not be in the best interest of the employee to do so *(ibid)*. However, how exactly surveillance and data tracking of employees is enacted is deeply embedded within an organization's social fabric [1, 12, 21].

A third aspect of accountability relates to who has access to the location-based data produced through manual or automatic ways. Gorm and Shklovski find [14] that both data access and disclosure change over time, as does what employees are comfortable with sharing [2, 14, 24]. Employees do not always perceive tracking as a disadvantage. A study by Dombrowski et al. of precarious work illustrates this by pointing to how some low-wage workers consider the absence of tracking technology as a barrier to just working conditions [8]. For example, employees can use tracking to create alternative records and accounts about their working hours and address illegal underpayment. Tracking may not always exclusively serve managers, but may also be useful to employees, depending on their access to the data collected.

Finally, the questions we need to ask, Suchman *et al.* points out, when studying tracking and use of data are: who deserves protection, who is entitled to make judgments, and who is rendered as a focus when accountability structures are increasingly opaque [31] as with data-driven work. Data work itself is of huge interest to how accountability is pursued, since work digitization has resulted in new tasks across various professional domains [5, 7, 11, 26, 28]. Irani & Silberman find that as work becomes data-driven and distributed, crowd workers, with access to information about potential employers, helps them make informed work-related

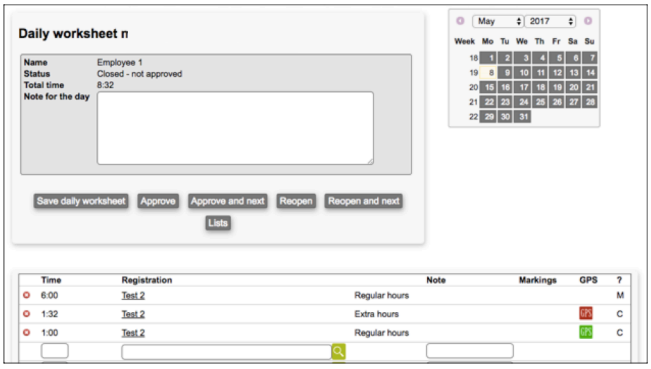

Figure 1. The time sheet for approval of hours: The "GPS"-column indicates whether the GPS-position, that was received with the "check-in"- or "check-out"-call, was at the position that the task is geo-tagged to.

judgments about who to work for [16]. Pine *et al.* [25], drawing on Suchman [30], have characterized accountability in the data-driven workplace by its "increasingly fine-grained measurements of organizational and individual performance," and point out how it is driven by a demand for work transparency with emerging data tools and practices [25 p. 3]. According to them, employees can be understood as data workers in different orders: the first order data worker is the first producer of the data, as the data does not exist before they produce it; while the second order data worker conducts additional work with this data, in effect adding to it and interacting with it. As data then continues to travel upstream, additional orders of data workers further interact with the data *(ibid)*.

The general increase in data work means that employees need to find workarounds [5, 17]. Understanding how to work around computational systems is likely a necessary skill in the data-driven workplace, requiring employees to construct the meaning of the different data objects of a system [10, 26]. Employees are also tasked with social effort, since data introduces new social relations. The employee contributes data to the company's accountability by anticipating and making legible data required for others. Thus, data work involves the articulation of data, for example, the anticipation, rehearsal, and performance of data to make technology (*i.e.* accountability systems) work in situ [11]. Building on this literature focused on data politics and accountability, we contribute to an understanding of the challenges and accountabilities produced for blue-collar workers when they become first order data workers.

METHOD

We conducted an observation-based qualitative study of the practical use of a CRM-system over a period of three months (in total, 47 hours) to examine the broader question of how different forms of work accountability are negotiated. The study was conducted in a mid-sized electrical company doing both regular electric installations and larger industrial sized climate control installations.

One of the researchers (second author) works part-time in IT support with the CRM development company. This insider knowledge helped the research team gain detailed insight into how the CRM system worked on a technical level. To address concerns of power dynamics and bias and ensure a multifaceted research account, a minimum of two researchers actively participated in the data collection and analysis. The CRM development company only provided the client contact information and was not involved in any other way.

As the study addresses sensitive issues on how employees negotiate accountability, a social phenomenon, it was important that the research team interact with people from different perspectives. The electrical company employs 70 people divided across three types of occupations: a) electricians, b) middle managers, and c) office-based workers, including the CEO. We observed all types of occupations to understand their role and how they each interact with the CRM-system as part of daily work.

a) Electricians: Two types of electrical work are carried out in the company: 1) in a team of usually two electricians working on a specific task in private homes, with one of them also serving as foreman. The tasks often involve private contracts, and, in general, these are smaller tasks that are completed in a day or two. 2) electricians' collaborating in teams at larger construction sites, under the supervision of a middle manager.

b) Middle managers (*foremen*) work partly as electricians, and partly as administrative employees. They have administrative responsibility in the locations where the company operates. At construction sites, one of the experienced electricians in a group of 4-8 electricians serves as the foreman. Usually, these groups have their own port cabin, where they meet every morning to delegate tasks and take breaks. Projects at the construction sites can vary from 6 to 18 months.

c) Office workers perform administrative tasks such as invoicing, salary, and coordination. They do not rely on tracking work hours by check-in and check-out in the same ways as the electricians and middle managers. The office workers and the CEO are situated in the headquarters, whereas the electricians and the middle managers stop by infrequently.

Case Study

The company procured the CRM-system for 2.5 years after they had grown and needed a better tool for planning tasks and tracking time. Before procuring the CRM-system, administrative tasks had been partly carried out on paper, and partly in different systems using, for example, PDAs, for time registration. All registrations of working hours would be handed to an office worker, who would then digitize the data and enter them into the prior system. With the CRM, electricians and the middle manager conduct these tasks, producing reports for statutory quality assurance forms, registering materials, documenting hours, and approving time sheets.

The CRM-system is a mobile and desktop-based system designed for the construction sector. As a cloud-based system, its design is based on the assumption that middle management sit in the office administering tasks (they are desktop-based users who access the system via web browser), while delegating work to personnel in the field (who are mobile app-based users). "Tasks" are a central data object in the CRM-system, around which much of the work in the system revolves, including invoicing, quality assurance, work hour registrations, and registration of materials. Invoicing is usually based on the registration of materials and work hour registrations. Work hours are registered either manually or through check-in and check-outs, and then saved on the employee's timesheet. Materials can be manually added by entering information about a product and searching a built-in product catalogue, or by entering EAN-numbers, either by scanning barcodes or manually.

The system also features location-tracking, which can be customized by each individual user. The settings are either "Never" or "During work hours." If the work hours are set from 07.00-15.00, the user is tracked during that specific interval, which can be set to anywhere between 10 seconds and 30 minutes. In addition, the users are also tracked every time they conduct a "check-in" or a "check-out". A timesheet approval page (Figure 1) contains the work hour registrations made by the employee during the day, along with a "GPS-column" and a "?"-column. The "?"-column indicates whether the time registration was performed manually (indicated by "M"), or by a check-in (indicated by a "C"). The "GPS"-column indicates whether the GPS-position, recorded with the "check-in"- or "check-out"-call, aligns with the task's geo-tagged position. If the GPS-marking is red, this indicates that the position of the check-in or check-out did not correspond to the position of the task, while a green GPS-marking indicates that the position matched.

Data Collection and Analysis

The study relied on observations of electricians (N=8), middle managers (N=3), office workers (N=3), and the CEO (N=1). Due to field site restrictions (construction work), the only semi-structured and audio-recorded interview occurred with the CEO. However, we conducted 18 *in situ* interviews lasting longer than ten minutes. This was usually the minimal length required to exchange robust information. Conversations fewer than ten minutes were counted as part of the observations. The *in situ* interviews covered various topics, ranging from clarifying observed practices, social interactions, and technology use, and discussing how the CRM system worked and noting challenges, how practices had changed since CRM adoption, how the system enabled electricians and middle managers to interact with various stakeholders, and how they imagined what other stakeholders wanted from the CRM-system.

The first and second authors conducted primary data collection. Scratch notes were written during the observation, and headnotes (a detailed summary) were written down shortly after the observation. Notes were entered into a coding scheme [13]. To compare data units, open coding was used to define categories related to how employees make themselves accountable as part of their daily work. We used grounded theory approach [13, 18] to develop the categories through an ongoing process of mutually comparing units of data. All authors took part in the data analysis that shaped the argument towards work accountability.

Our initial focus in the study was the work coordination between the office and construction sites. The company procured the system due to a perceived need to do more advanced planning of tasks. Therefore, we were surprised that the CRM system was mainly, but inconsistently, used for individual employee's manual tracking of working hours. In the following rounds of data analysis, our focus on electricians' data entries of working hours shifted toward the broader types of data entries for which electricians are responsible. It became obvious that CRM supports both manual and automated data collection, including location-based data, but the relationship between the two was less obvious.

Eventually, we shaped the analysis of this paper into a study of how data about work becomes a mechanism for the negotiation of work accountability, which we turn to next. We begin by introducing how electrical work is data-driven from the perspective of the electrician.

NEGOTIATING WORK TRANSPARENCY AND PRIVACY

Electrical tasks are performed collaboratively, for example, the installation of an industrial-sized climate control obviously takes careful planning and coordination. The solution, materials, and sequence of work are decided on collaboratively, even if sub-tasks are later distributed between the individual electricians. However, before we turn to the analysis, we will briefly illustrate how electrical work is data-driven by zooming in on the "simple" electrical task of changing a power outlet.

Changing a power outlet does not solely entail removing the old outlet and replacing it with a new one. After the CRM's implementation, this task entails several steps and subtasks, some of which used to be paper-based (*e.g.*, legal documentation), and new digitally-based ones (*e.g.*, data entry for client invoicing). To change a power outlet, the electrician must first digitally register in CRM by checking in as the task is initiated. Then, the choice of materials must be documented, in this case the particular choice of power outlet, by performing a search query in CRM. When the power outlet has been successfully changed, the time is digitally registered on the task for invoicing. A picture is taken and saved to the CRM system to document how the task was carried out in case of disputes with the client. Lastly, quality assurance forms are filled out for compliance purposes and the task in CRM is closed.

Although it would be a stretch to attribute the quality assurance demands entirely to the CRM, workplace mobile technology have made employer documentation easier to implement, in turn prompting an increase in such data-driven work. For example, one of the electricians responded to the question of how practices had changed since CRM adoption: *"There is now more [documentation work] than there was ever before."*

(*In situ* interview with Electrician, 19 04 2017)

The following section analyses precisely how the production of (a) location-based data, (b) metadata, and c) time-tracking data are interdependent with employees' understanding of what constitutes a reasonable level of detail and transparency about their work. Finally, we reflect on d) how electricians' skill sets influence whether they can effectively negotiate work accountability.

Negotiating Transparency with Location-Based Data

When data are automatically generated in the CRM, they are saved to the CRM servers for later use. For example, the CRM system is by default configured to generate location-based data about the electricians every 10 minutes through their mobile's GPS. These GPS-positions are saved to the CRM system, meaning that the electricians can be physically traced throughout their workday, regardless of how long it has been since the manual data was generated. When the CRM was first acquired, the electrical company's CEO had clearly explained to the employees and middle managers that he had not acquired the system to track the electricians, and that they should continue to have coffee breaks. A middle manager confirms that this is how the company explained the situations for which it would (or would not) use location-based data:

"When we first got it [location-based tracking] the boss clearly said that he don't give a damn if we take a break or a cup of coffee"

(*In situ* interview with middle manager A, 21 03 2017)

This was still the general idea, the CEO explained to us, but the CEO also pointed to more practical issues that had challenged the company's idea of how location-based tracking could be used. The CEO tried to make sense of the CRM data:

"When I ask support they keep saying it is because tracking is turned off in the particular mobile phone ... but when I ask the employee he says that he did not change anything... I am not sure how it works … but it [location-based tracking] is not important for me. We fundamentally trust our employees"

(Interview with CEO, 24 04 2017)

The quote illustrates how the CEO gave up on data analysis when the information he had received from support did not correspond with the electricians' answers. The CEO elaborated on his uncertainty about the data quality and

whether the electricians deliberately turned off the location tracking:

"I have only used it [data from location tracking] very little ... and I am not sure if they [electricians] are simply very good at turning off tracking ... in any case that is what I am told when I called [CRM support] to get an explanation of why I am not able to see [the location-based data] ... But then when I ask them [electricians] they tell me that they have not turned it off".

(Interview with CEO, 24 04 2017)

The CEO was not the only one trying to make sense of what was being tracked in the CRM system. For example, an electrician explained to us that he had turned off the GPS-function to conserve battery, and had never received any feedback about his missing location data. However, as the log files revealed, he had not figured out how to properly turn off the GPS-function, and was still sending location data to CRM,.

"After being employed in this company for a week I turned it off [location-based tracking] and I never turned it back on again".

(*In situ* interview with electrician, 19 04 2017)

Despite the CEO's overall belief that data from location-based tracking is not critical for how he runs the company, there were other divergent examples of data tracking use in the company. A second middle manager explained that he felt he needed more location-based data, particularly data that indicated where his team members were when they checked in using the app:

"Right now I can only see if it [the GPS-column] is red or green. I can't see if they [the electricians] are close by – or if they are on their way to somewhere else or where they have been. This is something that I would have liked to know ... where they have been"

(*In situ* interview with middle manager B, 25 04 2017)

The middle manager, who was responsible for one of the larger construction sites, approved the work hours registered by the electricians in the CRM. The procedure of approval of the work hours varied, and some employees were subject to more scrutiny of their registrations than others, the middle manager explained (*In situ* interview 21 03 2017). Here, approving work hours was an opportunity for the manager to take a closer look at the voluntary use and non-use of GPS tracking in the CRM.

Upon approving work hours, the manager was presented with a page that showed the work hour registrations completed by the electricians the previous day. This included the amount of work hours, the task that it had been registered on, a selected work area, and possibly an additional note. Furthermore, if the registration had been completed through the check-in and check-out function, this would be indicated with a capital "C" in the "?"-column, along with a red or green box labeled "GPS" in the "GPS"-column. Despite the CEO's suggestion that the company had no use for location data, the middle manager was systematically (and by design) presented with an indication of whether the individual electrician had checked in and out in the correct location depending on whether the "GPS"-column was showing as red or green for each electrician.

What we learn from these examples is how different company stakeholders oriented towards the documentation that provides evidence for work accountability. The CEO's general understanding diverged from that of middle managers when it came to the use and effect of location tracking. The CEO was uncertain about the data quality, whereas the middle managers did not question it, and did not talk to support or try to make sense of what was registered in the CRM. What we also learn is that one of the electricians—like the CEO—attempted to make sense of when data were saved to the CRM system; in other words, he negotiated the level of detail and transparency that he deemed reasonable to share. Saving the battery, he implied, was more valuable than saving location data to the CRM, because he would not be able comply with the other requirements (the documentation of work hours and materials) if his phone died.

Negotiating Transparency with Metadata (API, IMEI)

Another form of data that are automatically generated and saved to the CRM servers for later use is through metadata added about photo documentation. Photos are relied on in electrical work to document that a certain task was carried out in accordance with legal rules and requirements. Whenever a photo is saved to the CRM servers, it includes information about the particular mobile phone (*e.g.*, API and IMEI number for identification of the device that data was saved from).

From the electricians' perspective, their data work in this regard primarily consists of saving the photo to a particular case, albeit the actual action also captures metadata about the device, location, and time. Taking pictures of their finished work is not a new idea in the electricians' craft; before the CRM the electricians used digital cameras for documentation. However, the new addition of metadata saved to the CRM servers reduces the risk that an electrician will be accused of altering the photographic documentation of their work.

As an example of how electricians use photos, the electrical company at one point received a client complaint about the work they had conducted on an electrical cabinet about six months earlier. The client claimed that the installation was untidy, and demanded that it should be fixed at the expense of the electrical company. When confronted with the client's claim, the electrician pointed to the pictures saved to the CRM when the task was conducted (*In situ interview* 19 04 2017). These pictures showed that the installation he had made was tight and neat. Based on the electrician's evidence, the electrical company successfully deflected the complaint.

We learn from this example that various forms of data are captured in the CRM system by design. Nevertheless, automatically generated metadata saved to the CRM system was not relied on in the above situation. The electrician did not refer to the depth of automatically-generated data (authenticity of the photo) to argue this case. However, had the client disputed the picture's authenticity, this could have been used as further documentation to help the electrician to prove accountability.

Negotiating Transparency with Time Tracking Data

We now turn to how time-tracking data are used for negotiating work accountability. There are basically two states of time-tracking data: namely, a "use" state and a "non-use" state. The negotiation of work accountability typically manifested in the non-use of time-tracking caused by either: 1) *breakdown in the system*, or 2) *the electrician choosing to opt out.*

1) In non-use state situations, data generation has stopped due to system breakdowns.

Breakdowns in the system happened on several occasions, obstructing CRM data generation. For example, data generation stopped when the CRM system did not allow synchronization in the CRM application. This resulted in tasks being unavailable for checking in, registration of materials, or documentation.

The electrician on this occasion expressed annoyance about having to close the app and reopen it to force synchronization. Even then, the application did not fully update with new job information and functionalities *(In situ interview 21 03 2017)*. On another day, a different electrician experienced a similar breakdown in the CRM mobile app, and he was unable to check in to his assigned task. A third electrician working in a private home was also unable to see his task due to a breakdown.

The inability to check in illustrates how and why data that are saved to the CRM can sometimes be difficult to trace back to the individual electrician. In all three examples, due to breakdowns in the system, electricians had to remember the tasks they had been working on. Later that day, they manually entered the data into the CRM, based on their memory of how tasks were carried out.

2) Data generation can also stop due to a non-use of the CRM, wherein the electricians opt out of time-tracking.

Time-tracking is based on manual data entries, so the electricians have to actively engage with the CRM to produce the required data. The electrical company used particular measures to ensure that the electricians continued generating data. For example, a middle manager received a phone call from top management (*In situ interview* 25 04 2017) when he failed to follow the correct procedure of checking in and out of the tasks assigned to him.

After the phone call, the behavior of the middle manager changed, and he exerted effort to ensure that both himself and the other electricians' on his team generated data in the CRM. This call illustrates that the company took notice when there was a data discrepancy in the CRM data – and that the middle manager pays attention. Furthermore, it is also an example of how the company negotiates what is an acceptable level of data quality – and in this situation requirements were not being met, which is why the middle manager received the phone call.

Finally, it can also be difficult to trace data from the CRM back to the individual employee during the process of aggregating time-tracking data to invoice a client. The office worker aggregates the data once the middle manager approves the time sheet adjusted for, *e.g.*, breakdowns. However, even if data are complete and the CRM did not break down, data aggregation involves adjustments of the work hours.

Thus, when the client is sent an invoice, work is counted per half hour, meaning that wage is calculated differently than work hours. If the invoice was based on location-based data, the electrical company would not be able to charge customers in the same way, registering 30 minutes when the task was in fact completed in 15 minutes. The CEO elaborates:

"[Wage] is calculated based on the data from check-in and check-out [manually]. The employees are paid for... this can skew numbers because we go by the exact time... and then [name of the administrative person] calculates it into a round number.

(Interview with CEO 24 04 2017)

This illustrates the consequences of work tracking, since electricians shape their practices to comply with the CRM (*e.g.* making sure to complete the manual time-tracking and registration of materials). Both the employees and the middle management make themselves accountable in day-to-day work, based on the model representation of what accountability looks like in the CRM system: namely, the individual performance of tasks corresponding to the presence on site.

Electrician's New Skill Requirements

As electricians are required to generate data on a daily basis as part of their job, they must adopt new skills. They must understand the overall operation of the CRM in order to generate the required data. For example, one office worker struggled to figure out why a margin on a task was lower than expected, when they realized that the electrician had done some additional work that was not included in the fixed price of the task. The electrician had registered some extra work hours on the task with a note to explain it. Since the task was set to a fixed price, these additional work hours did not result in additional invoicing, which was reflected in the negative margin. As the invoicing becomes more automated, this requires the electricians to understand how to make correct data entries in the CRM system. Otherwise, "wrong" data entries can lead to decreased margins for the electrical company. The correct procedure, the office worker

explained, would have been to create a new task in the CRM, and then register the work hours and materials used on the new task.

In other words, electricians are required not only to generate data, such as correct work hour registrations and materials, but also to have a general understanding of the electrical company as a data-driven organization. Electricians must understand how data fit into corporate organizational practices so they can be reused across multiple company purposes.

As another new skill, electricians must know how to perform workarounds in the CRM. An issue that came up several times during our observations was how the search function for the materials was not suited to the electricians' needs. When searching materials, such as nails, screws, or cords, the tool only looked for the exact search phrase, rather than for the individual words. For example, a search query for "7m cord" would not produce any results if the material was labeled as "cord 7m." Therefore, the electrician had to guess or remember the right description of the material. To deal with the issue, electricians relied on different types of workarounds. At one construction site, the team of electricians would access a third-party website to search out the EAN-number [European Article Number] of the specific materials; a universal identification number for retail products. For example, a "7m cord" by "The Cord Manufacturer" would have a unique 13-digit EAN number that identifies that specific cord-type from that specific manufacturer. After identifying the EAN-number, the electricians would proceed to copy the number and paste it into the CRM. Another example of how electricians deal with this issue is simply by registering either a similar material, but from a different manufacturer with a similar price, or trying to scan the barcode of the material.

In this way, electricians negotiate what they deem to be a reasonable level of documentation as part of the day-to-day work. Even if the retailer differs, the screw or cord-type is the same, and the difference is unimportant for the company's purposes. Recognizing when no harm is done by workarounds to effectively complete data entries—as well as when harm may result—is an important skill for the collective effectiveness of the electrical company as a data-driven organization.

DISCUSSION: DATA-DRIVEN WORK ACCOUNTABILITY

The debate about accountability and new data possibilities for tracking and documenting work practices simultaneously impacts blue-collar workers and revises our preconceived notions of knowledge work in the data-driven workplace. In this study, we find that the electrician is increasingly regarded as a data-generating entity by carrying out tasks that resemble knowledge work. The electrician manually produces data on a task level (*e.g.*, work hours and materials for invoicing). As the electrician's work becomes further digitized, we may consider this occupation as first order data work [25], where electricians now directly generate key work data while considering its potential use. The CRM enables the electrical company to save all data about work in one system. Together, manually and automatically generated data enables the electrical company to produce different documentation for its customers and legal authorities. Such documentation practices introduce new questions about the reasonable level of detail for employees to share about their work. Van Dijck points to an uncritical dataism, which occurs when we are situationally required to provide information about ourselves and our practices to corporate data tracking platforms [33]. If we examine the inherent data politics for such workplace accountability computing systems, and the organization around it, we can explore the following: when and under what conditions does data tracking become surveillance? Who gets protection stemming from the data? Who has access, time, and resources to examine and interpret the data for their own ends? [31]. In what follows, we address some of these concerns, which lie at the intersection between accountability and data politics in blue-collar workplace computing systems.

Our study illustrates how multiple stakeholders reuse CRM data and how such reuse hinders and helps accountability for employees [8]. For example, the middle manager approves the individual electrician's work hours before administrators reuse such data on an aggregated level for client invoicing. Work accountability is therefore not simply negotiated as the detail and level of transparency provided by the individual employees about their work, but is also linked to collective client invoicing. During client disputes, data are traced back to individual electricians; however, with little chance of tracing either the situated conditions for data production or the processes of data aggregation, *e.g.* as is the case with invoicing to clients every half hour. By not allowing the electricians to collaborate around task documentation, responsibility falls on individual employees. This is troublesome, because while the data always connects to an individual employee, *much of the electrician's work is carried out collaboratively – something for which the system does not account*. Our study illustrates that the data representations we build into work systems matter for the kinds of work accountability we can enable [4, 9, 32].

The CRM system design misrepresents work as individual rather than team effort. Thus, the system misses the company's social fabric [1, 12] crucial to understanding active data based on individual action, which leads to misunderstandings by management when they believe that electricians are not meeting standards. Electricians and the middle managers discuss day-to-day tracking boundaries. Such boundaries are not fixed, but change over time [2, 14, 24], as is true in the case of location-based tracking of electrical work. The CEO emphasized that he encouraged his employees to act as they had always done and not to change their behaviors based on the new CRM system. The CEO explained that the data from tracking was only used for external purposes, such as client dispute cases, where a client

would question the location of the electrician and to offer documentation showing compliance with legal regulations. Meanwhile, electricians did not always trust this general assumption of what was articulated as a norm for workplace location tracking. Tracking in our case could be interpreted both as coercive and caring [27]; however, this framing neglects data tracking as a mutual process. Indeed, our findings illustrates that *it is in the best interest of the electrical company that electricians understand how to operate in the CRM, including how to work around the system* [see also 5, 17], since this is the basis for how the company demonstrates accountability to external stakeholders.

Yet, how do electricians negotiate accountability as part of their day-to-day work? A case mentioned above illustrates the skills required for employees to opt out of data tracking. Mistakenly assuming he had turned off his GPS-tracking (to conserve battery), an option that employees have in the CRM system, one electrician had never received any notification from his company that data was missing. For him, this was evidence that the data from the CRM system would only be required in case of a customer dispute. According to the work log, the electrician was in fact still sending location data, suggesting he lacked the competencies necessary to successfully decide when he wanted work data to be automatically collected and shared. What is also clear from our study of the CRM system is that *there is an element of skill in when people are tracked, which has nothing to do with compliance of the employees*, but rather with their data competence. Similar to what Heath and Luff find in their seminal study on documentation and professional practice [15], the data-generating electrician also must account for their highly situated practices using structured methods of documentation. As a result, electricians increasingly rely on finding ways to make data situationally meaningful for others inside and outside the electrical company.

There are certainly consequences if employees are not performing the required data entries in the CRM system. These can be divided into two categories depending on whether middle management or the CEO directly contacts the electrician. By notifying the electrician, middle management and the CEO can take direct corrective action when an electrician continuously generates low-quality data or continuously fails to generate data altogether. The lack of data generation could easily happen several times without action being taken by the middle management/ CEO, but eventually this would result in some corrective action (*e.g.,* a warning). Before taking direct, corrective action, the middle management or CEO could also take indirect actions, such as increased scrutiny on existing data, like work hours or materials registered by the electrician, to monitor data quality. An increase in workplace surveillance might skew the agreed understanding of work accountability and the company's norm. Meanwhile, a final important point in how work accountability is negotiated concerns the prioritization of the entire functionalities of the CRM system. The CEO intends that the 'bottom line' should be flexible enough to accommodate for coffee breaks, and not account 1:1 for how employees spend every minute of their time. Instead, the CEO still insists on a somewhat *inconsistent practice that allows the employees room for negotiation* in terms of what they deem a reasonable level of information to share and document about their work.

Finally, electricians have dealt with these new issues of negotiating work accountability and the level of data and documentation they deem reasonable to share about their work for years. In other areas, knowledge workers only recently began to see a real effect of data-driven work. For example, in the healthcare context, data collection and documentation is impacting the knowledge work done by various types of healthcare workers [25]. Doctors complain that the increasing demand for data and documentation shifts their focus away from core tasks (*i.e.,* spending time with patients; patient diagnosis and education; building rapport with patients). In other occupations, workplace technologies and data are used by stakeholders with drastic differences in social and economic standing, often to the worker's detriment. For example, on-call or flexible scheduling, defined as a work staffing strategy that enables managers to call employees in during busy work times, is very common in many service-based occupations [23].

Data is being tracked by employees and through employees regarding number of clients, productivity metrics based on employee performance, etc., which enables companies to shift economic market burdens from the company to employees. Likewise, in the context of the electricians, data plays a similar role in setting the stage to shift accountability burdens from companies down to individual employees.

CONCLUSION

This paper examined data-driven work, focusing on how employees' ability to generate high quality data in an electrical company becomes a mechanism for negotiating work accountability. Here, work accountability refers to the level of detail and transparency that electricians provide about their work, using a CRM system. In an observation-based study of the day-to-day data work of electricians in a mid-sized electrical company, we examined: *How do employees negotiate work documentation on a day-to-day basis, and how is the level of tracking adjusted accordingly?*

First, we demonstrated how the production of quality data is interdependent with employees' understanding of how to negotiate the level of detail and transparency about their work. As such, when electricians lack the skill to navigate how and when they provide data about their work, it is practically impossible to develop a good understanding of use and non-use, including a consistent practice around the use of CRM and acceptable workarounds. Despite the obvious risk of inconsistencies in automatic data generation, we find that middle managers are by design presented with data analysis on time approval sheets, and in some cases make use of it. From this perspective, skill matters both in

terms of electricians', CEOs', and middle managers' understanding of how data from tracking are produced, and how this data may be incomplete due to an 'flexible' incomplete practice. Skill, in other words, is a requirement for a boundary regulation process of the use of data from tracking, and cannot be assumed for any party involved. Avoiding the risk of increased tracking requires that electricians are able to conduct relevant workarounds to operate the CRM system, and thus also to be compliant by meeting the request for documentation in the CRM.

Secondly, we reflect on how data about work becomes a mechanism for negotiating work accountability. Accountability, we find, is based on some negotiation capacity, even if employees cannot exactly manipulate the CRM to achieve their desired level of transparency. The backwards tracing of responsibility that is embedded in the design of the CRM system does not take into account that most work in the electrical company is collaborative in practice. This is especially true for work carried out in the larger construction sites. When electricians understand how and when their manual data entries can be combined with automatically generated data, they can effectively negotiate work accountability, meaning in this case the level of detail and transparency they provide about their work. However, the company as a whole also benefits when electricians know how to maneuver in the CRM system, since this is the basis for how the company demonstrates accountability to customers and legal authorities. Thus, we demonstrate in the paper how work accountability manifests for manual labor employees' work as they themselves and the company rely on CRM documentation in the case of, for example, a customer complaint.

Lastly, we offer specific design implications related to work accountability.

Data and Design Implications

The design implications of our findings reflect how the day-to-day use of CRM is socially embedded; thus, the functioning of CRM, including the documentation of work, depends on employees' motivation to produce high-quality data, which is generally true for work tracking. It is important that employees have equal access and opportunity to develop the skills to operate as data-workers, our findings suggest:

1) Because the CRM is currently based on the tracking and documentation of individual employees – whereas work in a construction site is mainly collaborative – the scale and steps for a company to use and scrutinize the data should be clear to employees for them to stay motivated as producers of high-quality data.

2) The CRM supports data that can be aggregated and moved upstream; however, it is crucial in this process that any change made to data (for example, the invoice to clients every half hour – whereas employees check-in and check-out on the exact time) is transparent to employees and can be accounted for by the company.

3) Support and training is equally important to provide both management and employees with opportunities for the reflection and skill development needed to transition to data-driven work.

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