Managerial Visions

Stories of Upgrading and Maintaining the Public Restroom with IoT

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ABSTRACT

This paper examines the entangled development of governance strategies and networked technologies in the pervasive but underexamined domain of public restrooms. Drawing on a mix of archival materials, participant observation, and interviews within and beyond the city of Seattle, Washington, we look at the motivations of public restroom facilities managers as they introduce (or consider introducing) networked technology in the spaces they administer. Over the course of the research, we found internet of things technologies—or, connected devices imbued with computational capacity—became increasingly tied up with cost-reducing efficiencies and exploitative regulatory techniques. Drawing from this case study, we develop the concept of managerial visions: ways of seeing that structure labor, enforce compliance, and define access to resources. We argue that these ways of seeing prove increasingly critical to HCI scholarship as it attends to computer-mediated collaboration beyond white-collar settings.

CCS CONCEPTS

CCS → Human-centered computing → Human computer interaction (HCI) → **Empirical studies in HCI**

KEYWORDS

Restrooms, Internet of Things, Governance

1 INTRODUCTION

The development and adoption of Internet of things (IoT) technologies—networked objects imbued with computational capacity—for enforcing managerial priorities is an area of deep and ongoing concern within the field of HCI. On one hand, HCI scholarship has long examined the conditions in which exploitative and extractive labor relations unfold [70,72,73]. Important theoretical concepts have developed out of this research, including the notion of invisible work that highlights the labor hidden within industrial practice [70,73]. On the other hand, recent scholarship has explored the forms of technopolitics and governance arising out of the development of new computational technology to shape a wide range of activity [39,64], even everyday health and hygiene practices [3,6]. Across the private and public sectors that computational systems affect, these technical developments have taken on new significance and even garnered fierce criticism. "*What if your supervisor could identify every time you paused to scratch or fidget, and for how long you took a bathroom break?*" one skeptic recently asked about Amazon's filed patents for smart employee wristbands [77].

Before we respond to this question of *what if*, this paper considers the people who manage public restrooms as they deploy—or consider deploying—networked technology in the spaces they administer. Public restrooms comprise sites of crucial infrastructure and coordinated facilities maintenance that encounter billions of people each day and yet remain little explored within HCI literature. While the intersection of bathrooms and IoT may appear far from contemporary discourses of innovation associated with Silicon Valley, such always-connected devices and platforms of algorithmically informed decision making are increasingly prevalent in all forms of modern life. In the case that follows, they begin to structure experiences of hygiene access.

Drawing from our analysis, this paper develops the concept of managerial visions: ways of seeing that structure labor, enforce compliance, and define access to resources. This notion takes inspiration from Charles Goodwin's juxtapositions of the judgments made by archeologists looking at dirt and those made by the jurors at the Rodney King trial, a concept Goodwin calls *professional vision* [30]. He describes such forms of vision as social accomplishments, which offer structure to the professional worlds experts inhabit and are "answerable to the distinctive interests of a particular social group" [ibid:606]. Demonstrating the stakes, Goodwin examines the expert testimony of the defense in the trial of four police officers charged with use of excessive force against King. He explains how jurors were convinced to acquit the defendants, in part, due to the witness' detailed translation of a video depicting the beating (e.g., highlighting physical cues). Through this articulation, the officers' actions read within the realm of professional practice, despite wide controversy over the verdict.

Here, we describe the transference of moral and professional codes from restroom labor onto IoT to argue that managerial vision relies upon a complex web of coordinated action developing within the domains of public health, municipal governance, corporate supervision and, increasingly, networked technology development. Together, we argue, these assemblages define public resource distribution and, in significant ways, straddle a tenuous space between exploitative regulatory techniques and cost-reducing efficiencies. Following other restroom regulatory designs (e.g., blue lighting or short restroom stall doors [12]), networked technology such as smart soap dispensers help managers monitor, analyze, and prompt workers to take more efficient action while doing mundane activities such as cleaning their hands. Extending

the current state of restroom facilities (including municipal budgets), these technologies offer an oblique channel of communication back to the manager.

To arrive at this argument, we draw from a mix of archival analysis, interviews, and participant observation conducted between the winter of 2015 and the winter of 2018 within public restrooms across the City of Seattle (ranging from public parks, libraries, day centers, and community centers). This research offers two core contributions to the CHI community. First, we share a case study of how the people who manage restrooms (e.g., managers, custodians, corporate staff) encounter and consider installing networked technology in the spaces they oversee. By detailing the decisions they make to adopt such technology across public and private sites, we show how they work out the unevenly distributed and classed nature of restroom resources. These observations offer a glimpse into the coordinated work of facilities care in the Seattle area—and in other parts of the United States (as product manufacturing firms seek to spread their reach).

Second, we offer managerial visions as a concept that explains how people see shifting infrastructural logics around resource distribution. We find that supervisors adopt managerial visions at different levels of influence and at different degrees of proximity to the sites they manage in ways that guide the local distribution of hygiene resources (e.g., tampons, toilet paper, soap). To show this, we detail how IoT systems installed in restrooms may allow for certain forms of accountability while further devaluing domains of service work and public life already subject to surveillance. Notably, from the second half of the last century onward, immigrants and women of color increasing comprise the janitorial workforce [21,29]. As an example, the systems that monitor the frequency with which employees wash their hands may not only cut costs, but also perpetuate middle class ideals of cleanliness beyond health codes. In this process, we illustrate how managers have begun to adopt IoT systems in ways that foreground efficiency in a changing labor market.

The paper that follows examines managerial visions in three parts. We begin by reviewing related literature in the field connected to forms of accountability, governance, and market logics. We then explain our methods and turn to several cases that explore the nature of IoT developments in restroom management. We end by discussing the wider stakes of managerial vision for computer-mediated collaboration beyond sites typically associated with data driven labor.

2 LITERATURE REVIEW

The HCI community has long highlighted the role that digital artifacts, tools, and infrastructures play in the coordination of action between people, particularly within workplace settings. Such scholarship suggests that it is not only possible for people within a given space to have different sorts of relations to the sociotechnical systems present, but within the workplace, in particular, power spreads unevenly across use and administration of technology. Early efforts of participatory design, for instance, sought to contend with a managerial impulse embedded within emerging systems seen as threatening the skilled labor of workers on the ground [5,8,22,23,73]. Technologists worked alongside trade unions in opposition to "managerial prerogatives" that sought to divide and control labor for the primary purpose of accruing capital [22:251]. Alongside design led initiatives, social scientific accounts chart the new forms of categorization and information technology that usher in shifting patterns of visibility and accounting within organizations [10,63,72,78]. Highlighting those organizational relations, recent studies interrogate the politics of measurement in sites such as healthcare, nonprofit organizations, and environmental analysis [9,63]. We situate the work at hand within this ongoing line of inquiry that seeks to recognize and contend with the "new choices [laid] open by these technologies" [78:7]. In the sections that follow, we describe two central conversations to which our work contributes: collaborative or public approaches to the internet of things and studies of the regulatory structures that define the labor and use of these and other technologies.

2.1 Collaborative IoT

HCI investigations of IoT examine how the devices become situationally tied to emerging forms of data collection, analysis, and codification [54,65]. Grounding the discussion, Fischer, et al. [25] use their deployment of an IoT system for the monitoring of energy consumption to examine how advisors with a sustainability center in the UK and their clients collaboratively perform data work. The authors argue developers and designers "cannot simply install a bunch of sensors, collect and process the data, and produce a situationally relevant and actionable answer" [ibid:619], instead designers should consider the social and relational qualities of the IoT data at the onset. Complementing this work, Strengers argues in-home display systems providing energy and water consumption feedback often rely upon economic models that value efficient, rational decision-making in ways that imagine home dwellers as "micro-resource managers" [71]. Drawing on Suchman, Strengers calls for an understanding of resource management that recognizes the contingency of everyday interactions, noting one's abstract aims and desires may altogether be different than social and cultural expectations (e.g. cultural norms around hygiene often dictate how regularly one showers, which might conflict with aims of water conservation).

Moving such concerns into the domain of public life, DiSalvo and Jenkins describe the design and deployment of a sensing platform that monitors the relative ripeness of fruit to be foraged in trees throughout the city of Atlanta [16]. In their reflections, they detail the appropriation of commercial technologies for diverse community economies. Balaam et al. describe the design and deployment of Feedfinder, a mobile phone platform for evaluating the suitability of the physical environment in supporting a community-oriented public health initiative locating sites for safely expressing milk [6]. This recent work sits in conversation with that of scholars who have used IoT devices to instrument urban landscapes, toward efforts to sense pollution or noise levels [47–49] and help residents advocate on their own behalf through the distributed collection of data [17,74].

2.2 Forms of Accountability, Governance, and Market Logics

In parallel to this discussion of IoT developments, HCI scholars have focused on the workplace, examining the nature of the collaborative practice that those emerging systems mediate as well as the power relationships in which they intervene. In "Making Work Visible," Lucy Suchman outlined the tradeoffs of rendering certain aspects of work practices visible to others within organizations [73]. Star and Strauss [70] expanded this argument, elaborating the circumstances surrounding different labor conditions and describing how increased visibility may also come with new forms of accountability as well as potential burdens of communication and surveillance. For example, they highlight the challenges of trying to make nurses' work demonstrable while retaining important aspects of its ambiguity and the use of discretion. More recently, the work of Dombrowski et al. describes the information practices of low-wage workers seeking recourse for instances of wage theft [18]. Levy and Barocas chart "near-future" retail technologies that are set to impede on this varied visibility, in a process the authors term "refractive surveillance" [50]. Through the tracking of granular customer data, corporate entities also learn about processes of sales work happening on the ground. This information is, in turn, used by management to reshape retail work through efficiency seeking systems such as dynamic scheduling or initiatives that externalize worker knowledge. Such investigations build on early discussions by exploring additional forms of labor or oversight placed upon those in traditionally undervalued professions, and the economic, legal, and political relations that surround them [18,46].

A related body of HCI work has built on these insights, looking inside and beyond the technologies employed. Where Jackson and colleagues call for considering HCI's role in policy development [40,41], Lindnter and Avle consider the ways technologists already "tinker" with governance [52]—exposing the role innovation discourse plays in a broader figuring of citizens as entrepreneurs (see also [38]). Others examine whether emerging workplace codes become enforceable [64]. Among personal devices, such regulatory questions have begun to take root in work by Houston, Jackson and others around the right to repair movement where new regulatory structures may support the need for consumers to take apart and fix an escalating number of devices (without violating their warranties) [34,35,66].

This concern for the market logics underpinning HCI technologies pervades recent literature within science and technology studies and related fields that highlight the unexpected and potentially negative consequences of digital platforms. Scholars such as Safiya Umoja Noble [61], Brendesha Tynes [62], Kate Crawford [15], danah boyd [11], and many others have surfaced ongoing tensions between the platforms that artificial intelligence researchers produce and the socioeconomic and racial inequalities they may inadvertently obscure and deepen. Far from "neutral," Google search algorithms, Nobel shows, further marginalize oppressed groups such as women of color (returning a search for "black girls" with pornographic content, for example) [60]. As HCI researchers and designers, we face new challenges around subverting market logics in order to protect those whose data on which they draw and rely.

We draw together these concerns on the varied forms of accountability in sites of computer mediated work with studies of regulatory structures entangled with and extending technological notions of progress and compliance. In doing so, we seek to engage the "mess" of ubiquitous computing as it unfolds [7,20]. The sections that follow explore the pervasive but under-examined domain of public restrooms, where we find the co-development of governance strategies and networked technologies.

3 METHODOLOGY

To understand the co-development of governance and networked technologies within public restrooms we focus on the motivations of managers organizing these spaces. In particular, we draw from ethnographic fieldwork spanning several years (from the winter of 2015 to the winter of 2018), including a wide range of interviews and ethnographic observations with members of facilities staff at parks, community centers, libraries, and shelters, as well as representatives of industrial restroom product distribution firms. To contextualize this empirical work within wider media narratives, we complement interviews and ethnographic material with the collection and analysis of marketing materials, promotional videos from multi-national "personal care" infrastructure corporations, and additional archival resources described below. Though representations circulated by corporate actors frequently depict office buildings, rather than the community spaces we observed, the product market is directed toward those maintaining spaces of public and semi-public use all the same. These historical accounts situate our empirical insights in a wider chronology of stories on the distribution of public hygiene resources.

Although we conducted fieldwork with restroom patrons and other users of the facilities we studied, we learned that the experiences that proved most informative were those that reflected how the people who manage public restrooms viewed the facilities they supervised (elsewhere we discuss in more detail the perspectives of users of restrooms [26,27]). This focus enabled us to trace shifting perspectives on the introduction of networked IoT technologies within restrooms as well as understand facilities managers as HCI "users" and thus broaden the typical user-centered gaze to consider who figures such use to begin with. That is, we explored what shapes managers' decisions to put HCI systems (in this case, networked IoT sensors) to use toward opportunities for both accountability and potentially extractive forms of digital surveillance.

• *Ethnographic fieldnotes.* Our ethnographic fieldnotes were developed from first-hand accounts of restroom facilities managers collected over 6 months by the first author as she worked at two Seattle-based hygiene centers as a custodian and a front desk volunteer. One center specifically served women and children and the other served all genders; both offered free access to restrooms, showers, and laundry. In parallel to this fieldwork, we produced fieldnotes based on ethnographic observations with staff of the Seattle Parks and Recreation Department, Seattle Public Library, and our home institution's facilities organization (visiting 46 restrooms in total). We created an inventory at each restroom (taking note of hygiene products and facility conditions) and

organized this initial data on a city map in order to examine spatial relationships to access. In this fieldwork we documented organizational policies, as well as material resources such as paper towel dispensers, hand dryers, sinks, mirrors, toilets, toilet paper rolls, condom dispensers, trashcans, and, in rare cases, operational menstrual product dispensers.

• *Interview data.* We conducted interviews with key informants across each of our field sites. This work included 15 interviews with members of municipal maintenance organizations who each detailed entities that guided their work (e.g., city directives, guidelines, etc.). Additionally, we interviewed three representatives of the largest manufacturer of menstrual product dispensers in the U.S. We complement these interviews with over 50 informal conversations with Seattle librarians, staff of the Seattle Parks and Recreation Department, staff of recreational facilities, and our home institution's facilities organization.

• *Archival materials.* We collected archival material across each of our field sites and, by tracking industry-related publications and conferences, we focused on sanitary maintenance and facilities management. The items we analyzed included articles and news circulated through popular trade press venues, video recordings of interviews at industry expositions and conferences, and "vision videos"—or, "corporate research videos that represent possible future sociotechnical worlds" [76:122]. In focusing on "near future" proposals outlined by corporate outlets, we follow Levy and Barocas [50] in our interest in understanding the ways in which visions of a perfectly managed washroom get produced, and how technologies they imagine could impact those on the ground.

We analyzed our data thematically using inductive techniques of contextualized grounded theory [14]. This approach allowed us to foreground the emergent forms of managerial oversight within public restrooms and the role of maintenance work within them. We developed reflexive memos based on our field notes and other empirical materials and reviewed them together during weekly meetings. We then iteratively revisited and refined our interpretations across later rounds of analysis, building emergent foci such as our interest in governance, moral compliance, and managerial vision. Following narrative ethnographic traditions, we present our findings through vignettes, in ways that are meant to contextualize and represent thematic patterns that emerged within and across our data [13,31]. The sections that follow organize these vignettes according to a range of managerial visions of we encountered: from non-technological to technological, from local to national, from municipal to industrial, and from current to future-oriented. In drawing together these narratives, we build toward a textured understanding of managerial visions and what they reveal about internet of things devices that have begun to take root in restrooms.

4 FINDINGS: Regimes of Maintenance

In what follows, we weave together managerial perspectives around restroom maintenance across three sections to tell a story that increasingly builds to inform our understanding of public resource access. First, we describe how local municipal maintenance staff and managers judge who deserves to have access to particular hygiene resources in public and how these values are embedded into the design of the public spaces themselves. Second, we explain what informs innovation of hygiene-related products, which not only affects the ways in which these products can be served but directly impacts the values embedded in public restroom facilities' designs. Third, we detail a new Internet of Things device suite, which manufacturers bill as an all-encompassing system for restroom management and the ways in which it may impact current forms of access and maintenance labor. With each section, we seek to highlight key themes relating to the development of managerial vision as ethnographic vignettes to offer a glimpse into the complex social and material worlds we encountered.

4.1 Differential Accommodation Before IoT: How do people who do managerial work decide which resources to make available in the restrooms they oversee?

Throughout our fieldwork and interviews, we learned how forms of moral arbitration operated unevenly within various public sites. Prior to widespread installation of soap dispensers in Seattle public park restrooms, for example, the city labeled soap a "courtesy," a product that district managers could offer differentially based on their preferences. In one interview with custodial staff, an administrator to a district head named Debra described how the city introduced soap to restrooms in municipal parks, a relatively new addition from the 1990s. It was one "very adamant" resident, she told us, who "gathered the forces, communicated to all layers of government," and convinced those at the head of the parks department to revise their policy on this form of hygiene infrastructure. Prior to this advocacy, Debra explained, soap was left for individual area supervisors to decide if it was worth the cost and additional labor to upkeep. From a maintenance lead named Linda, we later learned that it was not just any adamant resident, it was the spouse of a city councilmember. Linda claimed he also took up the cause, advocating to his colleagues in city government who, in turn, put pressure "back down" on the department. Those who tended to get their voices heard and their needs met, Linda told us, were the ones who had "time on their hands" or "know the system"—likely those already in positions of prominence, as the case of the soap illustrates.

For others, such modes of influence were less available. Early on in our research, public restrooms were described by patrons as both incredibly important and unreliable, particularly to those with unstable access to housing. In one instance, a volunteer at a local day center recalled her own attempts to gain access to a restroom facility while she herself was unhoused. It was the winter, so the park restrooms were closed, she told us, due to a process called "winterization." [1] When she was later refused at local

[1] Starting in the late fall for several months, certain park restrooms are blocked off in a process called "winterization." Facilities managers told us this was done to prevent pipes bursting due to freezing. Several custodians contradicted this account, insisting instead it was a way to cut down labor costs by hiring only a few full-time maintenance workers and supplementing with seasonal employees during the summer months.

coffeeshop, she defecated in the alleyway to the side of the building, in both an act of necessity and protest.

During our fieldwork we rarely observed explicit acts of defiance, but we frequently heard stories, and each story told us something about different organizational actors' motivations for introducing varied forms of technology for public resource distribution. From defecation on the ground to graffiti, moments of difficulty, frustration, and resistance made lasting impacts on the decisions people made around facilities.

Although we would soon learn of a few ways that workers exerted agency by challenging notions of design from above (described further in the discussion) further conversations with others at day centers and social service agencies initially reflected similar senses of frustration and desperation. "There's not much access to bathrooms," an interviewee who was without regular access to housing stated. Describing her efforts to secure hygiene resources on a regular basis, she continued by stating simply, "it's frustrating. I try not to talk about it." Even in sites regularly identified by social service workers as accepting of a broad set of city residents such as parks or libraries, patrons found limits to access. "A lot of the time when you go to the parks, those bathrooms are locked so just because it's got a bathroom doesn't mean it's unlocked and accessible," reported one public restroom patron. A woman with four children living between multiple domestic violence shelters highlighted areas of the city which were particularly difficult. "I've been out there. Even with my kids and especially downtown, it's rough," she told us. Library staff offered programs on job readiness and financial literacy and kept a social worker on staff in order to connect patrons with social services across the city, which were expressly meant to support the unhoused population who spend time there. And yet, when it came to hygiene resources, staff expected visitors to come in having already addressed that need. In fact, during the course of our fieldwork, the library formally established a set of guidelines on the level of hygiene expected of visitors. One directive explicitly stated that patrons of the library must not possess a foul odor. If violated, the rule specified that visitors would be asked to leave the space. Cited by many of our interviewees as one of the few places in the city where people could still congregate and spend the day without the expectation of making a purchase or paying a fee, the library was an especially crucial resource to the city's unhoused population. Yet, these new regulations cast a shadow over its status as a reliable site for those seeking forms of refuge.

Augmenting the Restroom with Regulatory Fixtures

Accentuating our interviewees' ideas of who can or should have access to hygiene resources in public spaces, public restroom facilities managers expressed particular visions of appropriate behavior materialized in the development of physical amenities. In one interview, a public services coordinator at a local library named Dana described a widely held suspicion among the staff that when the library restrooms underwent construction, architects worked with its administration to dissuade certain kinds of behavior. The installations included the placement of blue cast lighting (rather than white or yellow, as might be typical in commercial buildings), which she described as making it more difficult to locate veins under one's skin and thus dissuading intravenous drug use. She also described the installation of abnormally short bathroom stall doors, designed to give library staff and maintenance workers the ability to quickly register (without bending over) whether someone occupied the restroom stall "properly"—in other words, not lingering for long periods of time, lying down to sleep, and so on. She further described customized sinks with a depth too shallow to bathe in. All of these design decisions within the space of the restrooms acted as a means of extending the control of managers and regulating the behaviors of those who used this space. Despite stated support for the city's growing population of people experiencing housing insecurity, the library's newly constructed bathrooms seemed to focus regulatory attention predominantly on the (real or perceived) behavior of those groups, people who relied on sites like the library as safe, dry places to dwell throughout the day.

Gatekeeping Strategies and Jean's Menstrual Mission

To further contextualize the ways managers determined what values they encoded into the spaces they supervised, we turn to an encounter with Jean, a community facilities manager whose statements exemplified some of the moral judgments we heard expressed again and again by the municipal maintenance staff with whom we spoke.

Jean and Sarah Fox met in a large meeting room at the well-equipped community center she oversaw. She sat gazing out from floor to ceiling windows as groups of children played on the indoor basketball court and several more rushed through the halls on their way to the pool. As we talked, Jean described the center as the ideal place for families to congregate with small children during the week and to host weddings or graduation parties on the weekends.

Early on we learned that Jean regularly offered menstrual products to visitors despite the fact that this practice was not, in her words, "something [her colleagues considered] a standard responsibility." According to several district managers, Jean offered more than what they considered to be sufficient in terms of care resources. Jean recalled for Sarah her first experience addressing the inaccessibility of menstrual products within the space. About a year into her new role as manager of the center, a visitor asked Jean for a pad. From that point on, she became determined to stock menstrual products behind the front desk, paying for them with funds from a small petty cash budget and giving them out "mostly to teens" who visited after school. "Every now and then a mom," she added, "but not very often because, you know, moms are prepared."

Jean then led Sarah to the restrooms and took time to describe each object installed. Soap dispenser, it was there affixed to the wall next to the sink. Toilet seat covers, they were there as well in each stall. Toilet paper was there too, in a mid-grade dispensing mechanism made of plastic. She paused after naming the condom dispenser (featured exclusively in the men's restroom), telling Sarah she'd fought the health department "tooth and nail" when a top-down directive from the city required their installation throughout parks and community centers around Seattle. "These people just came in and said these are going in and they were

already fed up with me over them because I said, we really don't need them here, we can give the kids a condom if they want one," she stated with lingering frustration. When Sarah asked how she saw people making use of the condom dispensers, she stated, "upon installation somebody broke into the boys [restroom] and took the money" and every now and then "some kid will buy one [condom] and fill it with water."

In some ways, Jean emerged as an advocate around menstrual hygiene support. Still, the fact that condom dispensers were opposed represents a larger issue concerning the allowance for some sorts of access (on the part of newly menstruating teens) but not others (like those with the intention of pursuing forms of sexual intercourse). The resistance to seeing condom dispensers as a necessary and appropriate addition to the restroom space contrasted with her support for "sanitary napkin dispensers," in Jean's words. Subtly, Jean bargained for the right to regain her role as arbiter of access to reproductive health resources, saying instead she could provide condoms for "kids" who asked her directly. According to Jean, the condom dispensers promoted activity that disrupted how the center was intended to operate: as a place for families or perhaps, more specifically, as a place to house mothers and their well-behaved children. Interestingly, we later learned the condom dispensers she and other managers opposed were funded and installed by the public health department (a separate entity to the parks department with its own funding) and administered through an outside vendor (not the parks facilities maintenance crew). Thus, the presence of condom dispensers had no real baring on the absence of menstrual product dispensers, as suggested to us. Instead, the public health department had simply not deemed menstrual access a priority, and neither had the parks department. Turning to the window facing the street, Jean shifted topics explaining that people who used the center's public lawn for resting were without the right. "They've got 10 minutes or I'm calling the police," Jean insisted. "The grounds people will come in and clean up their mess if they leave it, you know, like their clothing and needles, you name it, it's out there. Very sad!" Seattle, like other major cities on the West Coast of the U.S., faces a housing crisis with surges in rental costs increasing over the last decade and the rates of displacement along with it [36]. Facilities managers like Jean saw this phenomenon evidenced through the number of people who had begun sleeping around the community center. There was no room, in their minds, for accommodating people on the outside of the center. According to several of the municipal workers we spoke with, the people who improperly used the space needed to be removed immediately.

Through encounters with Jean and other facilities managers, we saw how each unit (even within the same organization) had their own way of determining the types of resources made available to the public and the quality of the experience of gaining access to them—in turn, scoping the types of communities these spaces are designed to support. We found notions of hygiene begin to appear in the form of enforceable rules, infrastructural elements, and individual or organizational policies. Within Seattle public restrooms, for instance, we saw judgments around managerial agency show up in mundane amenities such as the condom dispenser, but also architectural aspects of restroom design. From the height of a restroom stall door to the design of ceiling lighting, the spaces designed to give access to hygiene resources—and the way the people overseeing the spaces described their role within them—exposed a process of shaping the sorts of bodies imagined to be in need of maintaining.

4.2 Economies of Access: What motivates the development of IoT for public restrooms?

Having explored the uneven distribution of hygiene resources and how it gets encoded in restroom facilities, we now consider the managerial judgments that continue to shape those differential forms of access. During our conversations with facilities managers, we found that their ideas of what public resources (or "amenities") were necessary intertwined with institutional concerns for profit, ultimately driving certain kinds of innovation around public restrooms. We saw this emerge most immediately around our discussion of the cost of hygiene resource dispensers themselves. From public restroom facilities managers we learned that devices such as the menstrual product dispenser could run upwards of $300, even for older models. Sometimes manufacturers who produce the products to fill the dispensers offered educational or enterprise organizations a set of machines to install for free, with the expectation that they will enter into long-term and lucrative contracts with their company. Other times, facilities managers explained, manufacturers charged organizations for the machines as well as the items meant to go inside. An organization's ability to negotiate for low or no cost machines became a defining factor in their administration of hygiene resources. Savings began to justify the integration of novel computational systems into the spaces they managed.

Appeals to Savings

Nearly every time we discussed menstrual resources with facilities crew members they expressed a deep frustration with the idea of introducing more machines. Often an opaque box, the dispenser design could make it impossible to see how many items were left—making any engagement with them then a bit of a gamble, they explained. The visitors we spoke to described dispensers as a last resort before make-shifting something out of other materials available in the space (e.g., toilet paper). Despite their interest in solving maintenance problems with new machines, the facilities managers we interviewed sometimes described a similar dissatisfaction—spending hours maintaining their menstrual product infrastructure, struggling to keep track of the single unique key for each machine, or troubleshooting broken devices. Machines often featured signs of struggle, where someone may have tried to break in after a failed attempt at buying a tampon or pad. As staff told us, this might have occurred because someone did not have coins or wanted to take the handful of coins that might be inside. The dispenser was a brittle object, custodial staff described. Reparability here proved difficult, with small, indispensable parts and few options other than replacing coin mechanisms or installing entirely new units.

During our discussions with facilities managers as to whether or not they would introduce a new machine or IoT device, we learned of the important role product distributors played in

framing such interventions as upgrading. Facilities managers frequently entertained pitches from distributors during periods of contract bidding in which large suppliers that distribute hygiene resources like paper towels would vie for exclusive contracts. We learned through our fieldwork that sometimes the suppliers would offer free machines as part of a long-term contract, while other times they might make an explicit pitch that a novel device such as a stainless-steel tampon dispenser would be easier to clean or less likely to degrade over time. Facilities managers, then, in their words became interested in "upgrading" the spaces they managed because distributors convinced them (or, they wielded the pitch as discursive tool to justify such upgrades [see [28]) that such replacements would mean less overall maintenance. If the machines were harder to destruct, the pitch went, managers would save time and money in the long run by appealing to reduced repair and replacement, and presumably to labor savings as well.

Appeals to Private Sector Innovation: Hank, Clinic Quality, and Legacies of Managerial Innovation

A notable example of these organizations was Clinic Quality, a corporation that showed us how the interests of employers could easily come before those of visitors. At 100 years old, Clinic Quality was one of the largest U.S. manufacturers and distributors of menstrual hygiene products for the "away from home market." Along with toilet seat covers, "air care," gloves, and sorbents, they manufactured the products in their plant in rural Arkansas.

Through our introduction to Clinic Quality, we heard a story about the large multi-national "personal care" corporation Kimberly-Clark amassing a large surplus of bandages that they had manufactured for wounded soldiers during World War I. Hank, an almost 40-year veteran of Clinic Quality (and who now served as their VP of Sales) described that when the war ended, the Department of Defense refused to pay for the surplus supplies—asserting that the overproduction was not their problem. Then first lady Edith Wilson stepped in, forming a committee and paying Kimberly-Clark $100,000 to find an alternative use for the hygiene products. That's when the CQ-67 disposable pad was invented, Hank claimed. Since then, the corporation had turned it into one of the most common menstrual resources still used today (and, in a form mostly unchanged).

While compelling, we later learned that Hank's story was largely untrue. According to archival documents we attained from the Museum of Menstruation, Kimberly-Clark was not the first to invent the pad (a German version proceeded them by a few decades), and Edith Wilson's commission did not spur the innovation. Instead, it came from WWI nurses using bandages as a form of disposable menstrual rag [24,33]. The part of the story that was true —Kimberly-Clark only pursuing the idea after the war when they had excess—was crucially not an example of early 20th century business incubation, Kimberly-Clark or Clinic Quality, making this industry. Rather, it was an example of care work, the nursing expertise that informed necessary wartime adaptions.

Yet Hank's story is helpful in reflecting a particular understanding of innovation held by several managers we interviewed: namely, that such technological progress is partially tied to mechanisms for managerial oversight. He attributed an important product innovation to the minds of those who he viewed as an elite, hand-selected set of American patriots squeezing out the last bit of wartime economic prosperity. Government waste was avoided through the invention of an industry and American consumers covered the cost, exposing the role of emerging infrastructure in managerial ideals of restroom maintenance and regulation. Hank's story projected a top-down, managerial perspective on menstrual infrastructure. He framed product development from a manger's view—it started and ended with people like him.

Following this story, Hank told us that restrooms would be "going to IoT," a concept he described as "self-governance." In this vision, networked objects imbued with computational capacity would allow for the objects to manage themselves. Touch-free toilet seat covers and aerosol dispensers already tracked the number of releases between maintenance visits, but the newest soap dispenser models could do more. Specifically, Hank continued, they were designed with office settings in mind to record counts of usage alongside information about employee restroom breaks to verify what he called "compliance," or whether one washed one's hands in accordance with company policy or health standards.

Assuring cleanliness, modesty, and efficiency, the infrastructure Hank and others described seemed to enable hygiene product manufacturers to foster particular social values such as the need for surveilling employee activity. When they described self-governance, the "self" referred not to the employees (people overseeing themselves) but to the IoT (networked sensing technology taking on employee oversight). The aerosol and toilet seat cover dispensers could keep count of product levels and switch an indicator light on when they were empty, avoiding some of the maintenance effort of unnecessarily filling machines. Perceptions of machine capability shifted with the final example of the soap dispenser. The soap dispenser extended managerial monitoring of employees' hygiene practices. Technological intervention hardwired notions of employee compliance.

4.3 Marketing IoT: How do manufacturers imagine public restroom IoT?

If managerial vision can be found in the speculative stories of those working at hygiene product manufacturers, it is also visible in the marketing discourse around the working IoT systems they produce. Marketing efforts expose how IoT products come to embody the ambitions of hygiene product manufacturers such as Clinic Quality above, but also emphasize the wider collective hopes, values, and expectations shared by corporate and municipal actors around public sites, such as Jean and other workers with whom we spoke. To understand this point, we turn to one such IoT platform called Onvation that helps explain where these visions of a perfectly managed future get produced. In collaboration with IBM, Kimberly-Clark (still a larger player within the hygiene market) developed the technology, Onvation, to address two key issues in the management of restrooms. The first issue concerned the efficiency of restroom care. Through expanding the network of sensors embedded in the objects installed within restrooms, Onvation promised to enlarge managers' gaze: enabling them to gauge from anywhere, anytime the levels of products inside of

restroom dispensers (e.g., paper towels, soap, menstrual products). The second issue concerned the increased usage of public restrooms. By revealing consumption rates of hygiene products over time, Onvation could help managers learn of any malfunctioning devices and understand the overall traffic within the restroom.

We learned of this technology during interviews with members of a Seattle facilities organization. Two members explained that representatives from Kimberly-Clark recently delivered their group a sales pitch detailing the ways in which Onvation might improve the day-to-day logistics of their maintenance work. Over the last decade, Seattle restroom building managers and the like had gained access to tools for monitoring energy and water consumption through intelligent lighting devices and dashboards depicting various breakdowns of the data. The sales pitch claimed that important information had been overlooked in this process. Additional data—from water and waste accumulation to flows of customers or employees through the building—could be gleaned from the restroom with new tools. "Bad restroom equals poor management," Kimberly-Clark warned [45].

Kimberly-Clark, IBM, and a Shifting Restroom Landscape

These concerns on management took center stage at 2017 Worldwide Cleaning Industry Association's North American (ISSA, for its former name International Sanitary Supply Association) annual conference where Onvation sat on the showroom floor. Seated in a semi-circle around a camera, IBM Client Manager Bob Warpinski introduced the technology along with two Kimberly-Clark representatives, Senior Manager of Global Innovation Kelly Earhart and Associate Director of Innovation Commercialization Excellence Lori Shaffer. The group presented a dual pitch around the modern restroom experience [37]. On one hand, shrinking facilities budgets and patrons' concerns on restroom cleanliness and upkeep put more stress on managers to optimize the material and labor available to them. On the other hand, for the public or those who use the restrooms, spaces were becoming more and more crowded with people (what Shaffer called "densification")—thus affecting the quality and experience of restrooms cared for with traditional maintenance procedures in effect for the "last 100 years" [ibid].

Kimberly-Clark had toyed with the idea of the networked washroom for almost two decades, Earhart noted, pointing to a patent filed on sensing toilet paper usage in 1999 [55]. Due to "cultural and logistical" constraints, the patent argues, there was little knowledge on tissue habits such as the amount of paper used, the duration of time when the paper is used (or, how long someone is using the restroom), and the number of discrete pulls on a toilet paper roll. To address this, the filing introduced a sensor system that would record and analyze this information in a manner undetectable by the restroom user. With their most recent push, Earhart explained, Kimberly-Clark adopted what might sound like a user-centered approach. She described interviewing stakeholders about their "pain points," defining the problem into solvable chunks and designing for optimal customer experience [37]. While doing so, Earhart pushed the "fail fast" ethos, suggesting that one ought to "prototype early, prototype often […] It doesn't always have to work; it just has to deliver an experience, some semblance of where you want to go" [ibid]. Through their collaboration with IBM, she continued, they were able to take the seeds of the ideas illustrated in their patents over the past two decades and realize them, using both their technical material offerings (e.g., Watson IoT and Bluemix platform) as well as cultural cache (a tech company a century in the making). "We're not an IoT company," she admitted, but "with IBM behind us, that gives us credibility in the market" [ibid]. A bathroom company breaking into the technology sector, a disruptive move.

In highlighting disruption, the Onvation product recalls longstanding industries such as travel that have undergone dramatic shifts in recent years as technology startups, such as Airbnb and Uber, use streamlined software services to organize discrete labor and offload material responsibilities and liabilities onto the worker. These "disruptive" new services do not produce entirely new working conditions, but rather introduce systems in which particular forms of worker effort can be tracked and reviewed by company representatives (see [64] for more on the care and emotional labor taken for granted). In the case of Onvation, this disruptive technique is invited by corporate representatives who see value in associations with technology culture, rather than imposed from outside firms.

As if sitting between two worlds—one of the now and one of the future—the group on stage at ISSA offered a compelling image for managers. Shaffer insisted managers currently have "no data," no way to know when and how often supplies run low. Integrating Onvation into the mix of the maintenance infrastructure would "[provide] information to create that exceptional experience" [37]. Within their solution sat a proposal to "[put] people when and where they're needed," or to redesign the work routines of custodians and maintenance staff through forms of shift work and irregular scheduling.

According to Shaffer, Earhart, and other Onvation advocates, IoT systems managed to address the issue of restroom crowding alongside efficiency concerns, connecting them at the source. Automated software could assign individual workers their schedules based on analysis of this always-on tracking data, folding in aspects of the gig economy into traditional work environments. While this intervention might speak to the concerns raised by Shaffer on efficiency or cost reduction, historical and contemporary examples [1,2,56,58,67] have proven this practice to be one that is harsh for the worker (a custodian or maintenance staff member, in this case). This form of responsive scheduling creates an erratic working condition where hours can shift dramatically from week to week. One might receive their schedule with just a few days' notice and have little room to arrange for childcare, for example. The system might also send workers home early when it seems there is a lull in restroom usage, producing a situation in which people have a difficult time determining how much they might get paid during a particular month. This practice has come under recent scrutiny as employees of Starbucks and other prominent American chains detail the effects of such policies on their daily lives [43,44,57,69,75] and grassroots campaigns help herald in legal protections against similar techniques [79]. To Shaffer and the rest of the Kimberly-Clark team, instead of promoting precarity, the new scheduling approach makes custodians feel

"empowered" [37]. Having an iPad dashboard on hand or installing sensors in the dispensers they maintain makes "them feel like more of a service technician" [ibid]. Where custodians were once little valued within contemporary culture, proximate technology offers prestige.

Marketing materials later released by Kimberly-Clark reaffirmed the managerial futures presented at ISSA. According to their website, Onvation represented a critical transition away from isolated, in situ signage toward connected, proactive nudges promoting workplace pride [45]. Contemporary dispenser models typically offered simple signals in the form of LED lights indicating when a dispenser might be empty or full. The new system would instead collate product-oriented information with information about visits to the restroom to produce "actionable data, analytics and insights that can help building managers better manage their businesses by gaining control of the restroom" [45]. The company promised that monitoring enabled by the system would "cut costs, reduce waste, boost sustainability, optimize labor, and enhance your tenant satisfaction" [ibid].

In IoT technology, corporations like Kimberly-Clarke see an opportunity to seek out efficiencies and limit financial expenses by spinning the solution as a technology innovation. With terms such as "cut costs," "boost sustainability" and "enhance satisfaction," they frame the outfitting of restrooms with sensing technology as the solution to a variety of problems vexing wider contemporary systems of industrial capitalism—from environmental sustainability to the reduction of product and labor costs to improving customer experience. Taken collectively, the examples above point to how managerial logics underpin wider efforts at feeding those who supervise with data for decision making.

5 DISCUSSION

Since its establishment, the field of HCI has grappled with the computer-mediated management of spaces outside of the home [19,32]. The rise of networked devices has introduced another layer of complication to these processes, pointing to the increasing role of computing technology in the regional and national governance of public sites. This observation has led HCI scholars to expand the field's empirical compass to include emerging contemporary sites of digital work, from the flexible "venture" labor of technology entrepreneurs [4,59], to the extractive labor conditions of crowd workers [39], to the precarious circumstance of workers on the factory floor [53,68].

Contributing to this expanding body of scholarship, we have shown how the people managing restrooms make sense of the technological interventions proposed to shape and evaluate those spaces. Members of engineering firms and facilities organizations work together to envision using IoT devices to capture in situ data on hygiene product usage and use data analytics software to highlight inconsistences or aberrations. If the levels of toilet paper run low or if someone fails to wash their hands, for example, an alert may show up on the system's dashboard. The resulting ways of seeing this infrastructure—what we term managerial vision—can subtly dictate where people and things move within those public spaces (i.e., what hygiene resources are made available and to whom). Looking out from the restroom, we offer managerial vision as a concept that foregrounds the forms of labor oversight, compliance, and access structured by the way the managers look on the infrastructure they supervise. We close by considering how three facets of managerial vision—labor oversight, compliance enforcement, and access—may come to shape HCI research and practice ahead.

5.1 Structuring Labor: Contending with the Increasing Granularity of Managerial Oversight

Managerial vision organizes sites according to data captured at an increasingly granular level. As with Amazon's newly filed wristband patents (wherein haptic feedback prompts workers to take more efficient action) [68], companies such as Workday, Cogito, and Humaniyze use smart platforms to exercise expansive amounts of control over their workers in the name of industrial production (not unlike the rationalization Ehn describes [22:310]). In the case of long-haul truckers, according to legal scholar and sociologist Karen Levy [51], these regulatory infrastructures (born of both corporate and governmental oversight) produce forms of decontextualized data that are used to challenge workers' accounts of their own conditions and as metrics of comparison to promote competition against a traditionally distributed and relatively autonomous workforce—ultimately, shifting the labor dynamic of this industry at its core.

HCI researchers have sought to inform design specifications that take stock of technological environments in relation to the forms of labor that sustain them. However, as Jackson et al. explain, the field has comparatively few examples of work that seek to change policy-level regulatory structures (see [40,41] for a useful summary). This case study of public restrooms suggests the need for deeper reflection on how HCI technology regulation occurs vis-à-vis corporate values, expectations, and goals, particularly regarding the increasing granularity of managerial oversight. Turning inward to sites of frequent HCI study, this might mean attuning ourselves to the ways digital systems could be primed to subtly take on new forms of surveillance or extend what those in supervisory roles formerly had access to view. Elective programs of behavior change within the workplace, for instance, offer incentives for workers to set and track wellness goals. Foregrounding concern for invasive use of such information (e.g., to cap health insurance premiums or dictate forms of coverage offered) during the development process could help designers of these technological interventions create systems that combat misuse.

5.2 Enforcing Compliance

Our discussion of managerial visions has sought to anchor the approaches that corporate and municipal actors take to define and contend with perceived workplace challenges (e.g., waste, financial costs, increased usage). They drive the placement of responsibility for sustaining public access to public resources in networked devices and data analysis tools. In this translation, networked tools sharpen managers' moral sensibilities, but also allow them to govern through and with such systems (recall here Jean's campaign to allow for particular forms of access, but not others).

From condom and soap dispensers to wristbands, IoT opens possibilities for exploring the streamlining of worker actions, what Sheila Jasanoff has called "a legal and material hybrid" [42:9]. Like for the red traffic light Jasanoff describes, regulatory control may hinge on an enforceable rule that associates a material situation (e.g., a lack of soap use) with a disciplinary action (e.g., improving worker cleanliness).

With the stories of invention and IoT capability circulating around Clinic Quality, for instance, we see how the installation of IoT may allow the interests of employers to come before the privacy interests of those visiting or maintaining restrooms. Although imagined as employees within the story above, those visitors include anyone who might happen to stop in. A device meant to evidence employee compliance with hand washing requirements also belongs to the visitor off the street, extending the gaze of the manager into one of the most private spaces available throughout the day and allowing in the words of Levy & Barocas for surveillance beyond the "putative target" [50:17]. Data produced in and around public restrooms ultimately directs and defines managers' understandings of the performance of their employees and customers, members of the public (see also [50]). In this proposed future, managers' notions of necessity and modes of profit-seeking get refigured as central forms of innovation around public restrooms. Turning to discussion of how such visions might sediment elsewhere, consider recent car insurance company appeals for customers to install IoT devices in their vehicles exchange for discounts. How such practices could be made mandatory for those seeking coverage, used to infer information about surrounding drivers, or even subsumed into law enforcement regimes should be a part of ongoing and careful design consideration.

5.3 Marketing the Smart Washroom: IoT and the Corporate Imagination

This study has set out to expose the sometimes-subtle economic underpinnings of IoT technology and the capitalist logics that lurk beneath the surface. As desires for profit fuel municipal and institutional interventions, which themselves circumscribe the efficiencies produced, the relationship of IoT and labor to market forces deserves particular attention. Echoing Lindtner and Avle [52] in their study of transitional maker practices, we saw that profits and technologically-enabled efficiencies go hand in hand. Just as our research exposed these dynamics around public restroom administration, HCI scholars have probed market relationships to highlight the profit-seeking features of the field's own technological developments and researchers aims for "inevitable technological progress" [52:11] (see also [68]). The assumption that capturing more data equates to more efficient outcomes and thus produces a common good overlooks forms of oppression that may result while reinforcing capitalist ideals, recalling Safiya Umoja Noble's [61] discussion of Google search algorithms and the profit margins that drive them. This awareness of unintended consequences that disproportionally effect service workers suggests that the HCI community consider what it would take to combat such market pressures and the inequities they perpetuate.

5.4 Looking Out from the Restroom

The accounts featured here have illustrated how IoT figures in this managerial vision at multiple scales. At the level of individual soap dispensers, managers seek out networked technology to guard against liabilities, whether through monitoring the work of office staff (the cleanliness of employees' hands, for example) or by sustaining the functionality of public facilities (battling the vandalism and failure of dispensers, for example). At the level of hygiene product manufactures such as Clinic Quality, we saw the incorporation of digital systems for monitoring employee activity through multiple coordinated product sensors, contributing to new instantiations of managerial control through a comprehensive supervisory system. At the organizational level, our final example of Onvation exposed how the shift from mechanical dispensers to networked devices within restrooms may introduce new hierarchies of maintenance that could further the precarity of service work by making scheduled hours harder to depend on.

As the goals of industry increasingly intertwine with the goals of government, we find managerial visions play an important role in configuring the relationship between the two. Managerial logics intentionally obscure differences between manufacturing firms to make recommendations that generalize to new contexts and that render different firms more similar, reifying the very place of management in and around labor. As we saw at the ISSA Cleaning Industry Association conference, the shifting landscape of restroom technology points to a merging of public and private sector interests. Managerial vision, in this sense, does not only look at the laborer, but at the systems of management configuring the managers.

As regulating systems, IoT devices do not get built in far off conference rooms in isolation. Instead, they intellectually and practically rely upon the sorts of stories we circulate through HCI scholarship as well as in the pedagogical tools researchers have come to cultivate [5,29]. Our study prompts us to ask: what should HCI's role be in studying the managerial oversight of employees? What regulatory structures or protections for workers might our field propose? How might we promote or contribute to collations already active in advocating change? Reflecting on such managerial conditions, on the activities of managers and the systems for oversight they envision, it may be equally important to consider the ways in which we render such vision possible.

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