

# Watching Me, Watching You.

(Process Surveillance and Agency in the Workplace)

Sally A. Applin

Centre for Social Anthropology and Computing  
School of Anthropology and Conservation  
University of Kent, Canterbury, CT2 7NR  
sally@sally.com

Michael D. Fischer

Centre for Social Anthropology and Computing  
School of Anthropology and Conservation  
University of Kent, Canterbury, CT2 7NR  
m.d.fischer@kent.ac.uk

**Abstract**— *The notion that computers are somehow separate from our lives is misleading and ignores the level of integration that has emerged. Most of the processes that dispense, load, and deliver the supplies that sustain cosmopolitan life are impacted by some form of computer in one way or another. The systems created when networks of computers intersect with networks of people are shaping our current cultural environment and the way that we exist in the world. This phenomena has created multiple types of interactions that are hybrids between humans and machines and at present, the balance of human behavior towards other humans is impacted by processes in business and elsewhere that have an over arching governance based on machines. This limits human agency and impacts understanding, service and privacy rights for humans. Further, these processes increasingly depend on greater and greater quantities of what had previously been considered personal information, often scraped from online processes people do not anticipate, yielding an often revealing portrait of themselves. Also, a poorly configured paradigm has created a culture where, when systems are required for big business, people more often alter their behavior to suit machines and work with them, rather than the other way around, and that this has eroded conceptions of agency. We explore the use of Thing-theory to implement a partial means of implementing mutual surveillance between management and workers to increase human agency while developing more adaptive and efficient business processes.*

**Keywords**— *surveillance; manufacturing; polysocial reality; agency; multi-agent simulation*

## I. INTRODUCTION

Surveillance isn't a new idea. People have been watching others since they had others to watch. However, new ways of collecting, aggregating and processing information is driving surveillance to have the potential for a wide range of constituencies. This includes the capacity to contribute to the ongoing development of automation of processes which, when adhered to, will greatly restrict human agency. If we consider the workplace to be a structured environment that can, in part, be thought of as a "canary in the coal mine" test suite for pervasive surveillance, we gain insight on how surveillance techniques might play out on a broader scale.

Surveillance techniques used in the workplace go beyond merely capturing employees on cameras. Indeed, they constrict in a more overt way--via processes that are tracked and measured and require worker compliance. Furthermore, workplace surveillance is unevenly distributed; where a camera might record all parties for physical theft, process

adherence most affects workers on the lower rungs of the corporate ladder. The lines between public knowledge and personal privacy have been blurring for both workers and management with the adoption of mobile devices and data enabled smart phones. What process and surveillance most affect is human agency, the capacity for humans to make nondeterministic choices intended to advance toward a goal. When agency is diminished, or disrupted via surveillance or the process that requires them to follow a pre-determined script, humans are restricted using their abilities to independently think and problem solve creatively.

Part of the human experience is our heterogeneity, or differences from one another. In a global workforce, the heterogeneity of humans is compounded as multiple cultures interact together to conduct their work via messaging through communications channels such as correspondence, computers and telephones. Simultaneously, the rise of new communications behavior with the advent of the mobile web and social media has imbued an additional layer of heterogeneity to the global workforce on top of their usual communications, creating options for behavior that can disrupt and interrupt the production process as people check their devices for mail, send more messages, look up information and/or talk while they are working.

As the channels of synchronous and asynchronous communications increase, more extensive and complex interactions form and the information available to individuals becomes more variable. This results in the emergence of a structure we call PolySocial Reality (PoSR). Too much asymmetric information exchanged without enough overlap can lead to missed meaning. Unless this imbalance is compensated for critical information that can impact human cooperation and behavior in the workplace can be lost, misunderstood or forgotten.

Independently, due to globalization, companies have sought to control quality of production by defining more and more detailed processes and process scripts in an attempt to manage their highly heterogeneous workforce. From a management perspective, devising a 'common' language such as a process that is surveyed seems a smart way to keep workers focused.

However, it also limits their agency and surveillance techniques only further isolate and reinforce their heterogeneity. Bi-directional or multi-directional surveillance between worker and worker, and worker and management, might address this problem, enabling workers to retain some agency and quality of life, within the structure of the corporation.

We introduce Thing Theory, which describes a communal surveillance agent, a Thing-agent. A Thing-agent develops relationships between parties and shapes knowledge and responses for different actors within the system that it serves. A Thing-agent utilizes knowledge of a local environment, gained via its relationship to all people, roles and processes in the environment and to system-subagents and meta-agents in other systems.

## II. SURVEILLANCE IN THE WORKPLACE

The structure in an organization, particularly a global corporation, is complex. In order to contain the seemingly overwhelming act of managing a consistently shifting global structure, intermediate processes are introduced that help to run various tasks and functions. These procedures and processes create both a power structure (that is not always overtly recognized as such), and a process structure that is used to track and maintain the actions of a more massive organization. Historically, large organizations were generally governed by outcomes, with much of the process more or less under the control of groups or individuals who were evaluated mostly on those outcomes, and not the processes. Gradually, corporations began to dictate more and more of the content of the processes, partially in response to greater legal liability and reporting requirements, but also due to early 'data mining.' This led to corporate theories of how to maximize the impact of the quarterly report, including the idea that there might be some benefit from more control over processes. Some organizations even developed 'scripts' or near 'scripts' for many tasks. These scripts were (and are) put in place for various employees to follow in order to complete the tasks required by the organization to function. In a decision tree, there is the idea that contingency exists. In the case of scripts, the decision tree is moderated by a weak or false notion that the process could be intended to be scripted with almost all potential outcomes pre-calculated. This is different than expecting any type of free will on the part of a worker to execute the idea of the script rather than the script itself. Doing so would cause non-standard responses that would be more difficult for the corporation to quantify and utilize as data. This also may explain why such a surprise and puzzlement is sometimes evoked in the corporate sector when an employee/visitor/customer asks for something that is outside the range of the script.

These scripts are a type of automation for coordinating people as a part of the process and thus, require surveillance to evolve and be successfully maintained as such. Pervasive automation, such as the control mechanisms that enable the function of

drones, remote cameras, and the streamlined organizational process depends upon surveillance that must be put into place to both control and monitor performance and outcomes.

In the current workplace, corporations are using scripts to collect data with the goal of streamlining their internal processes. Recently, there has been much discussion of the tentative use of sensor-based tracking of workers to add to this process. In some ways, this is not new. Trucks have had monitoring sensors for some time to track driver attention on the road [1-3], and floor supervisors in the factories of the past certainly watched and paid attention to workers movement and habits. Every person carrying a mobile device with GPS is capable of being tracked, but it is not habitually used to affect or control their production. That said, the way that this particular type of sensor based tracking and surveillance is done in the workplace has generated discussion around privacy, human dignity, and the boundaries between people and their livelihoods.

Surveillance in the workplace is a vast subject. Current process script design with or without sensor-surveillance might be described by three principles:

1. Processes are created in the interest of cost saving, streamlining, efficiency, etc. and limit the free will of those enacting these by narrowing choice and experience that could be applied to the job.
2. The actions of individuals within these systems are recorded as data that is collected, aggregated, analyzed and reviewed.
3. New processes and procedures are created based on the interpretation of this data with little regard to the context of the human experience, except as required by law--and even then companies often attempt to skirt these laws [4].

The first principle of sensor-based surveillance inspired process design can be illustrated by the warehouse computer systems used in industry. Paperless order picking systems have been in practice for some time and usually involve a small computer, such as the Motorola WT400, strapped to the forearm of a warehouse worker. This allows for hands free movement, while the instructions are shown on the display [5]. The computer selector electronically receives an assignment, which directs a worker to the location, where they pick the product, and are able to stage it on a pallet [6]. In his dissertation, "Order Picking Supported by Mobile Computing," Hannes Baumann, suggests that "the development of these type of paperless systems were focused on the tasks of inspection, maintenance, manufacturing, repair, and training as potential areas where wearable computing might prove beneficial" [7]. In this way, paperless systems were developed to replace having to carry paper and pens and report in by turning in sheets at the end of the day, as the data from the paperless ordering picker system generated reports via computer. In addition, Baumann adds that "the fields of wearable and ubiquitous computing have evolved from the

creation of laboratory prototypes to examining systems deployed in workers' and consumers' everyday lives" [7]. Although Baumann's dissertation contains a thorough analysis of Order Picking, he neglects to indicate that there is a new area that these types of paperless systems might be focused on besides cutting down on paper usage. The sensors within them can be used for surveillance of worker movement and further, for monitoring compliance to script processes. This type of surveillance moves the rationale from tracking of data, to tracking of behavior.

A former Tesco staff member alleged that a Tesco warehouse in Ireland took liberties with their paperless order picking system computers, using the system armbands to keep track of their workers habits and productivity [8]. In summary, Tesco was attributed to using both gamification and surveillance type capabilities in addition to the function of collecting data about their work processes. Worker performance was monitored via a percentage score, which was claimed to be lowered if workers took a longer lavatory break and raised if they worked more quickly. Tasks were required to be completed within fixed time frames as well. The staff member added that people would be called before management if not "working hard enough." Of note is that many of the former staff member's colleagues who had to use the system armbands in the workplace were eastern European immigrants with limited English skills. The Tesco management had allotted a fixed time of 25 minutes per day for stoppages, but other time was monitored [8].

The difference in electronic tracking vs observational tracking is that there can be mistakes attributed solely to data analysis that lack proper context. Within this range, there is a narrow window of tracked behavior that must be adhered to. There is no room for fixing mistakes longer than the pre-determined time that mistakes must take, and even less room for individual creativity or ingenuity. The job expressed must only fall within the requirements of the job's specifications and now, if the claims are found to be true, the specifications of a time duration as well. In this way, the capacity for problem solving for the workers is limited. They have authority to fix problems, but only for the time allotted by Tesco. The windows of their ability to exercise free will decrease.

Sometimes, a corporation will engage in a behavioral tracking type of surveillance on their customers to inform their processes. This example is included because it is a useful illustration of how important context is when data and process are seemingly 'violated' in the eyes of corporate power structures. Elon Musk of Tesla was offended when a New York Times reporter gave Tesla's car a less than stellar review [9]. In this case, the reporter had free will for the drive and was free to write up the review. However, when the review was unfavorable, Musk turned the tables, saying that Tesla had recorded the drive and that they would release the reviewer's drive details, because all of the data of the drive proved that the reporter did not drive the vehicle correctly (violated the

unknown process script) and "drove in circles for over half a mile in a tiny 100-space parking lot" [10]. As the story broke, many noted technologists called for the reporter to be fired. The reporter wrote a thoughtful reply in more depth about his drive; it was colder than usual, he couldn't find the high powered charging outlets and didn't know he could use the slower ones, he didn't know he had to charge the battery to full instead of just topping it up a bit to keep going, etc. [11]. Proper context made a great change in the story evoked by analysis of the data and criteria for review. For surveillance data the context must be accurate and present, in order for the 'true' story to emerge. The situation we are seeing now is that stories are being created from data, with insufficient regard to the full context; data analysis and its subsequent story is used as the 'best' fit to the context expected and desired by the organization, not the context which is in place. If the reporter had had a script to follow, or was aware of one, in the way that Musk intended, perhaps he could have averted some of the problems he found on the road. In the absence of having specific instructions that addressed the reporter's unique driving experience and context, even the Tesla employees gave him differing opinions and instructions on how to troubleshoot the problems he'd encountered whilst driving.

### III. AGENCY

Agency is the capacity to make and execute nondeterministic choices intended to advance to a goal as events unfold. For example, humans exercise agency when deciding whether to move towards a light or to walk across a street to avoid a possible obstacle. Agency implies that people's future choices are not intrinsically fixed or stochastically predictable except on the basis of secondary principles of reasoning, such as rationality, cooperation or enmity.

Choices in this context are not generally preset or fully specified, but are relative to the goals of a person. That is, people are likely to dynamically construct their choices as they advance towards their goals, adapting to changes in circumstances and their progress as they do so.

The complexity of any situation with more than one person (exercising agency) increases rapidly, often requiring novel choices on the part of all people whether they are competing or cooperating since no person is solely responsible for most changes. The capacity for anticipating other people's point of view and what goals they may have and actions they may take is critical. People not only have personal points of view, but they must often be able to anticipate other people's points of view to make progress towards their goals and to instantiate their intentions in a manner that works.

The foundation of any social relationship requires a mutual presumption of agency on the part of the other; social relations require that each party assumes the other has some level of agency [12]. In an automation scenario, such as executing some type of corporate script, both worker and corporation forfeit some or most of their agency to the script.

Agency is moderated by social settings, but always with the knowledge that there are limits to this moderation if an individual is abused or over-exploited in the setting. Social interactions are moderated by cooperation and power, and both have limits.

Agency is also limited in corporate settings. How agency is conceptualized and instantiated in contemporary large organizations is in part, structured by the type of surveillance put upon the worker at their particular level of participation. In the performance of duties, agency is assumed to be mainly at the top, and decreases as one moves to the lower orders of the organization, usually the place where workers are required to execute scripts. As scripts are invoked, individuals have less and less overt agency (a kind of cultural version of the stigmery that organizes ants). Perhaps less recognition of others' agency emerges in corporations because most people in the corporate chain seem to have so little. In this conception, workers who are following scripts have little agency, but are able to express some solely through ineptitude or failure to follow instructions. Alternatively, people cloak their agency by appearing to follow script instructions as a cover for other activities that achieve the desired ends in an unauthorized manner. This organizational design is further undermined by the heterogeneity of staff from different parts of the world with different understandings and languages (remember our immigrant Tesco workers). However, the design of the system is set up to largely deny any attribution of individual agency by most of the underling workers.

In the case of scripts automating a process in the workplace, the agency of people is formally limited. If the scripted process is flawed, more ingenuity and 'disguised' agency is required on the part of workers to make the deficient system operate because their experiences are channeled into narrower and narrower processes. This is due to the design of the original scripts, the limitations of the computers monitoring them and the software for analyzing the data about their behavior.

The last principle of process design is that, unfortunately, the outcome of the first two principles is often used to design the next set of processes. This is the critical mistake, as the scope of human agency and the range in which we can cooperate becomes more constricted, the processes required for success become more fragile, and require more and more stealth-agency on the part of workers to maintain. In addition, as earlier generations of workers who developed a capacity for such adaptation retire, increasingly the workers in their place may come to accept the organizational design and may either not care to 'rescue' organizational processes, or not be inclined to do so.

#### IV. HETEROGENEITY

Society has become increasingly heterogeneous, comprised of people from many points-of-view using a range of channels for communication in multiple languages on multiple devices

running multiple apps, in multiple time zones [13]. PolySocial Reality (PoSR) emerges as people adapt to the pressures of having to manage multiplexed communication between themselves and others, and themselves and machines. Machines are not exempt. The more surveillance that is required from a machine, the more communications that machine must engage in with other machines. PoSR also arises in those circumstances.

PoSR is a conceptual model of the global interaction context that emerges when people and/or machines communicate. Each individual can exchange information with several different networks of individuals, and thus each individual has different access to information overall and thus a unique viewpoint. The outcome of the aggregate of these partially-intersecting networks and viewpoints is a multi-perspective meta-network that constitutes a complex environment for the coordination and collaboration of individuals. This becomes even more complex with use of the social mobile web and other new forms of communication that contribute significantly to instantiating intentions [14,15,12].

Conceptualizing people as embedded in a PoSR context has enabled us to make various observations: People are using asynchronicity as an adaptive strategy to being time compressed and having to do things online; people are multiplexing messages and tasks, and there is wild variation in whether or not there is temporal overlap between their messages. Sometimes the messages get through and sometimes not [16]. Fundamentally, we're concerned with cooperation and collaboration between people, for without it, we cannot survive.

For corporations that manage a global workforce situated in a larger scale PoSR context, an increase in heterogeneity can drive the evolution of process constriction (in the form of scripts or other types of surveillance) as an adaptive strategy. Because corporations have such a large range of diversity to manage, processes that are linear, simple and clear appear to help corporations control their environments and workers. Surveillance, tracking and scripts are automated ways for them to invoke a type of quality management or quality control. Unfortunately, the quality lens is often turned onto their 'process' and not towards the real-world processes that drive the outcomes of the service or work they are in the business of providing. This is the twist: surveillance of processes mostly reflect back on process and worker compliance and not on problem solving, product creation or other things that the corporations are in business for in the first place.

Companies appear to be using surveillance to both improve performance with little regard for the human being acting within their 'cyborg process,' and to collect data to use to develop these processes even further. Thus they continue to create the conditions that encourage even further commitment to this approach.

The problem is that the difference between the capabilities of

a human being and those of a mechanized process is usually quite vast. Furthermore, the intelligence that is inferred from behavioral data usually lacks sufficient context to create a process that can deal with the range of possible contexts that can occur. The only solution is to attempt to reduce the range of heterogeneous contexts as well as the people acting within these. Companies are trying to fit worker data to a process model, rather than using the data from the workers to shape the model and processes. The keystone being optimization of time.

By changing the way that they treat surveillance, corporations might optimize their processes in a manner that benefits both themselves and their workforce. This would involve two-way surveillance. The former Tesco staff member said, "The guys who made the scores were sweating buckets and throwing stuff around the place" [8]. If they were "throwing stuff around the place," perhaps it was inhibiting the performance of other workers who had to clean it up, or walk around it, or step over it or were unable to access the items they needed because things weren't in their place anymore, or any one of dozens of potential scenarios. If someone is wearing a device that is measuring their output, but their workplace is not comfortable or conducive for the success of their working tasks, in that context the only measurement that Tesco will get back will be that of a 'slower worker.' Having a process for workers to report back what is wrong—to exercise agency and, more importantly, time to do that, might increase their productivity in the long run. This approach involves changing a management structure that would redistribute the power of controlling at least some of the surveillance (of the work process) to the workers.

This, in part, is what Toyota did with "The Toyota Way." The Toyota method of manufacturing involves teaching workers the current 'Best Practices' for manufacturing and employees are expected to use these practices in their daily work. Workers are measured, but the measurement is about Toyota's process improvement, not necessarily the workers ability to adhere to the process. Workers are encouraged to have their own ideas about how to improve the process and to suggest them, but not to use them until they are accepted into the main process. When a worker's idea is accepted into the 'Best Practices,' all workers benefit and begin to use the idea [17]. Toyota makes having an efficient process their priority and encourages the workers to be guardians, stakeholders, and entrepreneurs in their vision. Workers in Toyota have the authority to stop the line if there is an error and other workers are encouraged to help with the stopped line issue to benefit the organization. In this way, Toyota encourages collaboration between workers, workers and the process, and workers and management.

On the whole, surveillance is not a bad thing. It does help to understand process, if one is able to account for what is going wrong and correct it. It goes wrong, when the extension of manufacturing machines is expected of humans, who have

their own creativity, ingenuity and agency to solve problems and complete tasks.

## V. AGENCY IN ORGANIZATIONS

We've suggested that agency in many organizations is limited for those in the lower rungs of the hierarchy and that when workers in these organizations do have agency, it is limited in scope. Things that may appear to be surveillance in an organization to a worker, might, if viewed through a different lens be a less well-thought-out management task with serious effects on staff that aren't consciously considered. If we gave the benefit of the doubt to Tesco, we could ask if whether or not their attempts to gather data on behavior and gamify the process is just a method to increase output while giving themselves feedback about their processes in real time. This might place it into a manufacturing category where the workers are considered to be individual cyborg processes and are optimized as Tesco might optimize their other machines. Perhaps Tesco is trying to squeeze every second out of workers to improve their company performance.

This last point is important, for the differences in worker agency by being forced to wear devices in processes that are so sensitive to linear time, can have the result that they lose most of the time they might have. This includes anything that could benefit from their agency either within or outside the scope of their jobs. In particular, detailed process requirements limit the possibility of workers employing asynchronous means of balancing work requirements to achieve a better mix of outcomes. In a time when workers are gaining more experience at being asynchronous in their lives outside the workplace, [16] this limits the application of these new skills in the workplace.

Even the consumer can become entwined in the corporation's 'script process' as a 'required feedback loop,' and not necessarily a human customer. At the Starwood chain of hotels, when a service is performed after a request such as asking for more towels or some other service, the staff is instructed to call the hotel room and ask for feedback about the process in the form of something such as, "Did you get the towels ok? Was everything to your satisfaction?" [18]. This is a form of quality management that puts the feedback of process of Starwood well ahead in priority to Starwood than of the time of the person in the hotel room, who had to make the initial request, then wait for the disruption to have the request fulfilled, then to be disrupted further by a call, named the 'Service Recovery,' asking for an evaluation of how the process did or did not address the initial request. It doesn't stop there, post-checkout feedback forms, Twitter requests, email surveys are all continuing demands for process feedback. The entire stay then becomes a vehicle for the processes of Starwood evaluating its processes.

From a management perspective, with a group of heterogeneous, diverse workers, devising a 'common' language such as a process that is surveyed seems a smart way to keep

the workers focused. Unfortunately, it also limits their agency and the surveillance techniques only further isolate and reinforce their heterogeneity. The corporations see the workers as a homogenous group focused on a task, but the workers remain diverse and are executing a program that does not work for each individual.

An example of how surveillance in the workplace with more agency for workers might succeed comes from the experimentation of different methods to encourage handwashing amongst medical workers. For example, the North Shore University Hospital on Long Island, New York is currently using “motion sensors, like those used for burglar alarms (that) go off every time someone enters an intensive care room. The sensor triggers a video camera, which transmits its images halfway around the world to India, where workers are checking to see if doctors and nurses are performing a critical procedure: washing their hands” [19]. This seemingly drastic surveillance procedure joins other attempts to get healthcare workers to wash their hands. After several studies, it was found that there was low compliance due to several factors, with the doctors (ones who usually have the most agency) amongst the worst at compliance. Some companies are manufacturing systems of sensors that monitor soap and water usage that can transmit feedback via badges that are worn by the healthcare workers. The workers receive a vibration to a badge attached to their person if they have not complied, allowing them to quietly rectify their error in a non-confrontational manner. Although these systems offer surveillance, they also allow for free agency in this scenario for any worker to not comply and still continue with their tasks. However, if healthcare workers do comply as they are tracked, they receive rewards. Public feedback includes ratings for a group of co-workers, but not the workers themselves, leveraging social motivations both to comply and to encourage others to comply. Thus, the regular contextual reporting of the ongoing outcomes of the surveillance of handwashing processes, individually and collectively, simplifies the integration of this important 'requirement' into heterogeneous complex processes that can only be achieved through individual agency.

One possible scenario is to avoid the plain 'transparency' argument of companies. It isn't just about the fact that they do this, its also about the effect this has on their workers as human beings and members of society. What is challenging for both workers and companies is the cohort problem: with more processes in place, workers are becoming less proficient in applying agency to solve problems. Corporations have to adapt to this situation that they in part created, by creating more detailed processes. This is twofold, the corporations continue to lack a workforce that knows how to solve problems 'in the wild' and they also lack increasingly any mentors for workers to learn from, as the older, more educated agency enabled worker cohorts are either laid off or retire.

## VI. DISCUSSION - THING THEORY AGENT MEDIATION

There must be a balance between quality control and quality of life. Allowing for agency and bi-directional surveillance might address this.

Thing Theory [13] is an agent based network model that utilizes knowledge of a local environment, gained via its relationship to both people in the environment and to system-subagents and meta-agents in other systems, who inform the Thing-agent of needed knowledge. Thing Theory is loosely informed in part on the notion of the character "Thing" from "The Addams Family," a 1960's television show based on a comic of the same name created by Charles Addams. Thing is characterized as a disembodied hand (and forearm) that has been with the family for many years and is described as both a 'family retainer' and 'friend'. It inhabits a series of tabletop boxes in different rooms of the house [20] that could be compared to a type of roughly cobbled physical network. Thing communicates with the family by gestures, sign language, writing out notes, or tapping out messages in Morse code. Thing serves the family by accessing a portal in contextual proximity to what is needed or desired at the precise moment required, in the precise room or context needed. Thing is not only a ubiquitous agent, but also an anticipatory one that migrates within the environment. The sensing, response and location-awareness of Thing is a useful aspirational model for a network agent in a location-aware Smart Environment.

Our Thing-agent functions as a communal surveillance agent. It develops relationships and shapes knowledge and responses for different actors within the system that it serves. The Thing-agent collects information on all systems, and could work as a model for our two way (or multi-way) surveillance. Not only could management track workers, but workers could track management to see when management needs their project completed so they can more effectively prioritize their time. A Thing-agent can serve a real need to revise and design processes so that they are not so brittle, fragile, or unidirectional.

If we examine the Toyota model, Toyota keeps track of their production in terms of subsystems, rather than individual people. The people function within groups that are part of interlinking processes that serve the goal of producing Toyota's products. This model of viewing groups of people as interlinking processes between subsystems gives people some space to use their talents and invoke knowledge of problem solving as it pertains to the tasks that they do.

In the North Shore University Hospital example [19], the people in the system are responsible for any change in behavior. The 'thing' processes (remote surveillance, site sensors) analyze information but only provide feedback and incentives for people to contribute to the desired outcomes, more handwashing, and thus, fewer secondary infections. This sets up a context where the surveillance is bi-directional;

people are privately informed of any surveillance outcomes that include themselves, while still being able to monitor and participate in the progress of their group as a whole.

In [13] we discuss possible approaches for implementing Thing theory in location-aware environments. A Thing-agent at a minimum is a means to inform users of the information about processes within a smart environment in pragmatic terms that make sense to those users. Ideally with a high level interactive interface that adapts to the POV of each user. A Thing-agent will include a representation of the pragmatic contexts in which processes are expressed. This is done such that the Thing-agent facilitates choices by user, rather than forcing them into specific choices.

In such a situation there are many complex contingencies that can arise. A Thing-agent might employ non-monotonic multi-agent simulations incorporating specifications for each process and that relates sensor-based information to present scenarios of possible ways processes and users might interact with each other. On this basis a Thing-agent can offer available choices to the user in different contexts, and provide feedback in terms of what is likely to occur should the user make a given choice, thus a basis for 'fine-tuning' how they proceed.

There are existing logics and associated software architectures for developing such multi-agent simulations in a manner to support decision making. Deontic logic is a good candidate for a useful semantics that supports constructing simulations of the type needed [21, 22]. Casto and Maibaum [23] present a deontic logic suitable for representing the interrelations of users with agency, and [24] discusses at length representing and reasoning with agency in deontic logic.

A Thing-agent mediated multi-agent simulation can be useful for designing new management/worker cooperation and knowledge exchange. Such an exchange could leverage 'simulation services' provided by a Thing-agent to support their decision making, and possibly improve the joint understanding of dynamic production environments. These simulation services would direct attention once again to outcomes rather than processes, since all parties could see different possibilities emerging from their actions in interaction with others. They could then alter course as needed to improve probabilities of a good outcome dynamically. This approach to process control would be far more adaptive and would favor outcomes over processes while leaving room for workers to deploy their individual skills towards achieving these outcomes. Exploiting a Thing-agent to ensure that the information that needs to be shared to support agency in the network of workers and managers is available to maximize the capacity for cooperation, and avoid the problems that can arise from PoSR networks such as missed or misunderstood messages, or connected individuation [24]. In a workplace environment, Thing-agents could be employed within a system of restricted privacy based on tasks, rather than tracking people's behavior.

Not everyone in the social environment of work fully knows the roles and responsibilities of what it is like to do each other's jobs. A Thing-agent type model could assist the process. In this way, two or multi-way surveillance may

become simply respect and cooperation to complete tasks rather than a measuring stick that erodes the agency of humans within organizations.

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