Human–Computer Interaction

ISSN: 0737-0024 (Print) 1532-7051 (Online) Journal homepage: http://www.tandfonline.com/loi/hhci20

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**To cite this article:** Paul Luff, Christian Heath, Menisha Patel, Dirk Vom Lehn & Andrew Highfield (2018) Creating Interdependencies: Managing Incidents in Large Organizational Environments, Human–Computer Interaction, 33:5-6, 544-584, DOI: 10.1080/07370024.2017.1412830

**To link to this article:** https://doi.org/10.1080/07370024.2017.1412830

HUMAN–COMPUTER INTERACTION, 2018, Volume 33, pp. 544–584

ISSN: 0737-0024 print / 1532-7051 online
DOI: https://doi.org/10.1080/07370024.2017.1412830



# Creating Interdependencies: Managing Incidents in Large Organizational Environments

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In recent years, we have witnessed the emergence of large-scale centers of command and control that bring together a range of personnel from various services responsible for the management of day-to-day incidents and events. These multicenter control rooms stand in marked contrast to what Suchman termed 'centers of coordination' (Suchman 1997), which have typically formed the focus of much research within HCI and Computer supported co-operative work (CSCW). In this paper, we explore the practices and technical resources within one of these very large multicenter control rooms. Staff in this control room do collaborate with colleagues who are copresent, but there is little reliance on the subtle interactional practices found in earlier studies. However, one information

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system is critical for collaboration and managing incidents that arise: the information system that is used to record incidents. Unlike in previous settings where records were made after an incident had taken place, these records are used for the concurrent management of activities. We consider the practices through which staff assemble these records to serve the demands of different individuals, with differing responsibilities in various organizations within the control room. We consider instances of copresent collaboration and suggest that these are often to ameliorate problems with the records rather than supporting real-time colocated activities. Although staff may be copresent in these multicenter control rooms, they have different kinds of technological resources available to them, and a different 'division of labor.' This can undermine the integration of these resources within forms of work. We conclude by discussing the implications for our understanding of copresent work and also for the methods and approaches we can draw upon for understanding these contemporary workplaces.

## 1. INTRODUCTION

Some twenty years back, Lucy Suchman identified a class of worksites she termed 'centers of co-ordination.' These were locations where participants worked together in the same space, where those participants had an 'ongoing orientation to problems of space and time' regarding the 'deployment of people and equipment across distances' and the 'emergent requirements of time-critical situations' (Suchman, 1997, p. 42). Suchman identified a number of ethnographic studies of such settings, which included control rooms of different kinds (Filippi & Theureau, 1993; Goodwin & Goodwin, 1996; e.g. Harper & Hughes, 1993; Heath & Luff, 1992; Suchman, 1993), emergency call-taking and dispatch centers (Whalen, 1995a), and trading rooms (Heath, Jirotka, Luff, & Hindmarsh, 1994). These studies have subsequently played a prominent role in our understanding of technology and collocated interaction, in particular concerning the interdependencies of individual and collaborative action. They have shown how relatively simply resources, including flight strips (Harper, Hughes, & Shapiro, 1989a), whiteboards (Goodwin & Goodwin, 1996), and large fixed displays (Heath & Luff, 1992), facilitated the coordinated production of complex tasks and enabled participants to sustain an 'awareness' of each other's activities. These studies made an important contribution to our understanding of colocated interaction, in particular revealing the highly contingent forms of co-participation that arise between small numbers of personnel within a strict division of labor. They also contributed to the development of CSCW, to concepts and theories, to methods for analyzing technology use in action, and the design of collaborative technologies.

At the time during which these studies were undertaken, many of these settings were already in transition. New technologies were being deployed that provided

enhanced access to activities and events beyond the center of operations, and new roles were being introduced and responsibilities assigned to manage additional tasks and activities. In recent years, we have witnessed further developments, including the emergence of very large control rooms that bring together staff who were previously dispersed in different control centers, and often not just from one organization; the intention was to deploy coordinated solutions to problems and emergencies that draw on the resources of many different organizations.

In this paper, we will consider one such center: a substantial multifunction, transport operations center in Central London. Responsible for traffic management and dealing with major incidents, this center of operations brings together three separate organizations and their respective operation centers – transport control, traffic management, and the police, within one control room. It houses more than a hundred personnel, located within various regions of the room, personnel with different responsibilities, reporting to different organizations, with common access to a complex range of information and communication resources. These personnel have to manage the problems and emergencies that inevitably arise in the day-to-day flow of traffic in a major urban environment. The coordination of problems and emergencies through a highly complex division of labor is a major practical challenge for staff and management. It also raises important questions for our understanding human–computer interaction and the concepts, methods, and ideas that informed more traditional studies of work and collaboration within control rooms.

In this paper, we will draw on fieldwork and audio-visual recordings to consider how staff integrate various resources, including the CCTV images of the city streets, audio accounts of emerging problems, and textual descriptions of incidents to coordinate responses with staff who are situated somewhere in this large space. We reveal how one particular technology seems to be critical for the coordination. Despite staff being copresent, a simple record-keeping technology serves as a critical resource for collaboration with and communication to others who may be nearby, the current status of any incident. We consider how staff both write contributions to this system and make sense of them and how these serve as a resource for diverse forms of collaboration within the control room, particularly for the concurrent management of incidents and events. This is in contrast to how such records were used in the original control room studies, where records of incidents and events were typically made after problems had been resolved and were typically used for post hoc analysis and review. This means that records are written in particular ways, through an economy of description that allows readers to make sense of those records for their own management of current events.

In the light of the use of this system, we consider issues that arise when staff do draw on their co-presence to support collaboration. Colocated colleagues can contribute to emerging solutions and staff can utilize the presence of a colleague to clarify incidents and help develop a response. However, there are distinct differences from previous studies in the way staff offer contributions and make their own activities available to colocated colleagues. It appears this may not be due to just the scale of the control room, but also with respect to the way work is organized and the resources staff have available to them. We conclude by discussing the

implications of our study for the analysis of colocated work, particularly with regard to earlier workplace studies of centers of coordination.

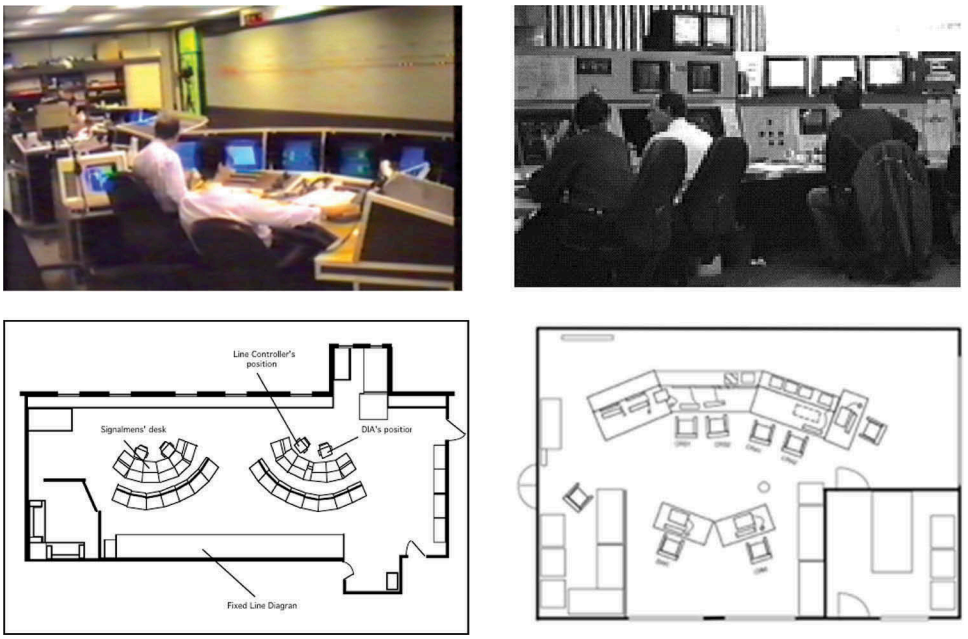
The data considered here differ from earlier ethnographic and video-based studies of copresent work. Those studies tended to focus on small groups of participants or on activities that had a common focus of attention. In these larger and more dispersed settings, it is a challenge to identify patterns of communication, whether staff are working in collaboration or separately, let alone reveal interdependencies between activities and warrant that those interconnections are relevant for the production of coordinated activities. In conclusion, we discuss the implications of this study to analyze the practices for the analysis of activities in very large, technology-saturated organizational environments.

## 2. BACKGROUND

Early in the development of the field of CSCW, a number of studies emerged that were of domains that were termed 'centers of coordination' (Suchman, 1997). These were typically ethnographic or video-based ethnographies of control rooms. They included studies of staff involved in the control of complex transportation systems such as air traffic control (Harper & Hughes, 1993; Harper, Hughes, & Shapiro, 1989b), ground control of airports (C. Goodwin & Goodwin, 1996; Suchman, 1993, 1997), and public rail and underground systems (Filippi & Theureau, 1993; Heath & Luff, 1992, 1996aa; Luff & Heath, 2000, 2002), as well as surveillance and operation centers (Heath, Luff, & Sanchez Svensson, 2002; Luff, Heath, & Jirotka, 2000), mission control (Watts et al., 1996), emergency dispatch (Whalen, 1995a; Whalen & Zimmerman, 1987), telecommunications restoration control rooms (Hindmarsh & Heath, 2000), newsrooms (Heath, Luff, & Nicholls, 1995; Heath & Nicholls, 1997), and trading rooms (Heath et al., 1994; Jirotka, Luff, & Heath, 1993; Luff, Jirotka, Heath, & Greatbatch, 1993). These settings were colocated 'hubs' of activities, focused on very particular tasks. Personnel with different responsibilities worked and collaborated in the same place, they needed to manage resources and have access to activities and personnel outside of that location, and they had a range of tools and technologies to support them.

Let us consider a couple of these studies, those of the Bakerloo Line Control Room and the Docklands Light Railway (see Figure 1). The control room is the principal location, a large room, where a service is controlled and monitored, from which there is an aim to ensure the smooth and safe running of that service. Each member of staff had different, but related, responsibilities in that room. Therefore, for example, one may have the responsibility for interacting with remote personnel (drivers), one for communicating with passengers, one for regulating the service, and one for monitoring the service of incidents. Even at busy times when an extra member of staff joins to help out, a 'working division of labor' (Anderson, Hughes, & Sharrock, 1989) emerges so that particular responsibilities are assigned to specific individuals.

**FIGURE 1. Examples of domains focused on in studies of centers of coordination. On the left, the Bakerloo Line Control Room of London Underground (*HEATH & LUFF, 1992*) and on the right, Docklands Light Railway (*LUFF & HEATH, 2000*). The Bakerloo Line had two principal consoles (for network and signal control) typically occupied by four or five members of staff. From all these consoles, a large fixed line diagram was visible. The Docklands Light Railway Control Room had one console, operated by four to five staff, with managers supervising these. Technologies included various screens for scheduling, routing, communication, and CCTV systems.**




There are a range of technologies and tools available to the staff to support their work, a number of these being embedded within a console. These include control, communication, and CCTV systems operated through keyboards and mice. Staff also utilize simpler artifacts, like paper timetables to help manage the service, and documents to record incidents and responses. There are also technologies that are more publically visible, for example, whiteboards providing notes of information that is currently relevant and perhaps most notably in the Bakerloo Line Control Room a large electro-mechanical display of the current operation of the service along the wall in front of the consoles. Indeed, the design of the space was oriented so that this display was visible to all participants. Moreover, other artifacts facilitated what and who was visible to another and when. Thus, for example, the curved desks in both control rooms allowed participants, when necessary, not only to reorient to their colleagues but also view the displays in front of them and, to some extent, the activities they were undertaking through these technologies.

Studies of these and other centers of coordination revealed how collaboration relied on subtle forms of interaction. Hence, for example, they revealed how participants integrated a range of resources to make sense of a complex environment and undertake appropriate actions. Control, communication, computer, and video systems were used alongside paper tickets (Harper et al., 1989b), material timetables (Heath & Luff, 1992), and whiteboards (C. Goodwin & Goodwin, 1996; Suchman, 1997). These physical devices seemed to have particular 'affordances' that supported coordination and collaboration not available on apparently more sophisticated technologies. Control room studies also made apparent the diverse forms of collaboration through which staff managed a range of different concerns. For example, studies that drew on video-recordings of moments of collaboration revealed how practices in these domains relied on subtle forms of interaction. By considering how visual conduct and turns of talk were coordinated in these settings, studies showed the ways a member of staff might organize their talk with a remote colleague on the radio to facilitate the entry of information into a computer system (Whalen, 1995a), or how staff were sensitive to quite subtle details of another's activities, even what they were typing into a system (Luff & Heath, 2000). These studies, informed by conversation analysis, revealed the practices that staff engaged in so they could be monitored, overheard, or overseen (Goodwin & Goodwin, 1996; Heath & Luff, 1992; Watts et al., 1996), for example how staff might read out aloud so they could be overheard, how statements would be produced using particular prosodies and pacing so they could be heard by staff who were not visible to them (Goodwin, 1990, 1996), and how turns of talk might be coordinated with visual conduct to imply specific courses of action that needed to be undertaken by a colleague (Heath & Luff, 1992, 1996). Such practices were necessarily embedded within the work practice of the setting; they were inexplicit and tacit. Moreover, these studies suggested how even distinctions such as those between individual and collaborative action might be problematic – individual activities like a phone call to another may be designed to be accessible to another person (Heath & Nicholls, 1997) or a glance at a large display may have consequences for colleagues (Heath & Luff, 1992). These practices were recurrent and underpinned the ways activities were coordinated when participants were copresent. Nevertheless, they were deployed selectively, relying on an understanding of the contingent demands of colleagues and the 'natural history' to events that staff had access to in the setting (Heath & Luff, 1992, 1996).

Those concerned with the design of development of innovative systems drew from the original studies of centers of coordination to suggest how novel collaborative technologies may be configured, for example, how 'awareness systems' may need to offer more sophisticated kinds of support (Schmidt, 2016, 2002), the importance of providing 'public' and not just shared resources (O'Hara, Perry, Churchill, & Russell, 2003), and also how the consideration of the properties of everyday artifacts might support collaborative activities (Luff & Heath, 1998; Shapiro, Hughes, Randall, & Harper, 1991; Sommerville, Rodden, Sawyer, & Bentley, 1993). More generally, they also informed models of collaborative action and coordination (Benford & Greenhalgh, 1997; Schmidt, 2011; Schmidt & Simone, 1996), ones that considered different kinds of situated awareness and peripheral participation. Indeed, they

continue to provide the background for debates and discussion about the concepts of 'workspace awareness' and other characterizations of 'awareness' within CSCW (Randall & Schmidt, 2016; Schmidt, 2002; Schmidt, Heath, & Rodden, 2002; Tenenberg, Roth, & Socha, 2016). Also noteworthy, these studies of copresent interaction revealed the close interrelationships between 'individual' actions with technology, typically considered the concern of human–computer interaction, and collaborative activities, the concern of the emerging field of computer-supported cooperative work: they blurred the boundaries between the two fields of research and also contributed to a reconsideration of how to develop analyses that took account of the wider 'context' of system use within human–computer interaction (Anderson, 1994; Button & King, 1992; Dourish, 2001; Suchman, 1996).

Studies of centers of coordination also showed the potential for adopting new approaches and methods within these fields. Thus, rather than drawing upon methods and forms of analysis from cognitive science and social psychology, workplace studies drew from social scientific orientations, particularly conversation analysis and ethnomethodology. They suggested the possibilities and value of detailed qualitative studies of workplace activities and interaction that drew from fieldwork, ethnography, and recordings of everyday behavior. It is, in part, due to these original studies of activities in centers of coordination that such methods are now commonly used when trying to understand the requirements for new technologies and from which to develop implications for design (Crabtree, 2003; Crabtree, Rouncefield, & Tolmie, 2012; Heath & Luff, 2000; Hughes, Randall, & Shapiro, 1992; Randall, Harper, & Rouncefield, 2007).

At the time of the original studies, many of these centers of coordination were already in a process of transition. For example, with regard to the Bakerloo Line Control Room mentioned above, there were a number of proposals including redistributing personnel so that additional strategical and management functions would be situated in the control room; merging several line control rooms together; and introducing technologies that, among other things, would replace the fixed line diagram (Heath & Luff, 1992). The study of the control room contributed to discussions of these initiatives and the possibility of moving toward configurations based on more conventional computer technologies, such as those found in the Docklands Light Railway Control Room, particularly systems focused more on the individual user (Luff & Heath, 2000). Since the time of the studies, the technologies used within similar control rooms have become more sophisticated and integrated. For example, the number and quality of images provided by CCTV systems are greater, these are not operated by simple switching systems but through graphical or geographical mapping systems, and often they are integrated into other systems so images appear automatically when incidents are flagged nearby.

Air Traffic Control Rooms were also faced with significant technological changes (Hughes et al., 1988), as were financial trading rooms, newsrooms, and emergency dispatch centers (Bowers & Martin, 1999). A few studies have been undertaken in control rooms where new technologies have recently been deployed, particularly associated with air traffic control (Berndtsson & Normark, 1999; Mackay, 1999), but as Aoki (2009) suggests, apart from Watts et al.'s (1996) very specific study

of NASA Mission Control, workplace studies of control rooms have tended to focus on interaction in control rooms 'in the small.'

Since the time of the original studies, some control rooms have become very large, the technologies that are being used now draw on more sophisticated visual and location-based technologies, require more electronic forms of communication, and there appears to be greater integration among tools, technologies, and devices. It would therefore seem worthwhile to revisit the control centers of coordination, at least to see how resilient the practices identified in earlier studies have proved to be, and if not, what kinds of practices have emerged to support collaboration and coordination in these large multicenter spaces.

We focus on the use of one particular activity that seems critical to collaboration within this large control center, both within a team and between the different organizations housed in this space. This is the activity of recording events and incidents. In control rooms, such as the Bakerloo Line Control Room and the Docklands Light Railway Control Room, staff would record events and incidents that had occurred. This was often for colleagues on a later shift, for other managers to review at a later date, or for staff who were not copresent. Hence, records were typically written in a log, in quite extensive detail, toward the end of a shift, often some time after the incident had occurred and had been resolved. In the control room we consider here, we find that the recording of incidents is more highly integrated into the ongoing management of incidents. It is also a resource for other colleagues as they also encounter the same incident. These records, apart from being entered into an information system, are also of quite a different nature – one that seems to facilitate copresent collaboration within this very large setting. We consider those practices staff have for assembling the records, but also how other forms of copresent collaboration arise to ameliorate problems in a record or to elaborate the descriptions.

## 3. THE SETTING

The setting we consider is a very large control room, one that may be termed a 'multicenter' control room. London's 'Surface Transport and Traffic Operations Centre' (STTOC) brings together three operations centers that were previously housed in different sites: the London Streets Traffic Control Centre (LSTCC), the Metropolitan Police Traffic Operation Control Centre (MetroComm), and London Buses Command and Control Centre (CentreComm).

The center monitors and coordinates traffic congestion, incidents, and major events on London's roads within the area of the M25 (about 600 square miles). The activities of the three centers are closely related: MetroComm manages the police response to traffic incidents, LSTCC controls London's traffic lights and traffic flow, and CentreComm is the emergency center responsible for the control and management of London buses. If we consider a few brief examples, it is possible to see how the responsibilities of the different organizations are related. A serious road traffic accident on a major road would require the police to deal with the emergency at the

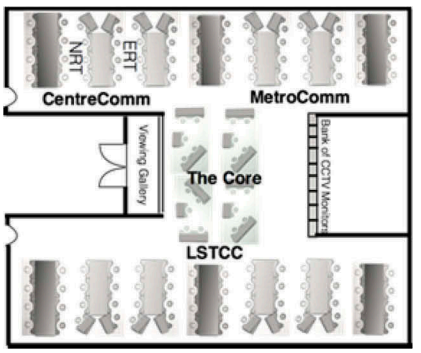
site. This may result in diversions being made to the routes of buses so that they can avoid the obstruction by travelling on minor roads, which in turn may need changes to be made to the phasing of traffic lights to support the flow of traffic. Or, consider a report of a potentially violent passenger made to CentreComm by a bus driver. This would need to be passed over to the police. Or, a planned political demonstration might require buses to be rerouted to travel down roads in the opposite direction to normal, needing temporary changes to road regulations, road signals, and signs.

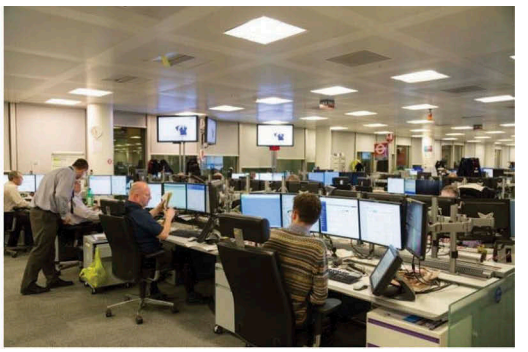
Given the interrelationships between these concerns, the three centers, which previously were at different sites, were integrated into one large space (see Figure 2). Together, there are approximately 100 staff housed within this operations center, responsible for managing road traffic in London. The space has many similarities to many large open-plan offices. It is divided into different zones for different teams, consisting of rows of back-to-back desks.

The number of incidents handled by the operations center is very large: there are approximately 1000 unplanned incidents a month, ranging from traffic accidents, passenger emergencies and unexpected roadworks, as well as planned traffic diversions for major events and more mundane problems associated with the city streets. CentreComm alone has to manage the operation of 8500 buses and handles 1500–2000 calls a day.

In this paper, we focus on staff in the CentreComm zone of the operations center. This itself is divided into two teams with associated managers and related staff. One team, the Emergency Response Team (ERT), principally handles incidents as they happen. These may be reported by bus drivers, the police, other local bus operations centers, or mobile staff employed by CentreComm. Members of the ERT have to make a first response to these incidents. They work on shifts throughout the day (24 hours) and

**FIGURE 2. The London Surface Transport and Traffic Operations Centre. The three operations rooms are located in different zones in the same physical space (see map, left). There is also a 'core' area that has desks where staff with general responsibilities, such as public information provision, are located. In front of this, covering one wall, is a bank of (32) large CCTV screens showing incidents occurring on the city's streets. On the right is an image taken of the CentreComm region of the space.**



typically there are six members of this team at any time. If any incident requires a longer-term response, for example, if it is likely to last a significant time (i.e. more than 20 min), then it is passed to a second team within CentreComm: the Network Response Team (NRT). Typically, members of the NRT plan diversions to the routes of buses. There are constraints on how these diversions can be made, for example, there may be low bridges, narrow streets, or local traffic restrictions that make a diversion impossible. Diversions can also disrupt the journeys of passengers, as they may mean buses missing out bus stops. Members of the NRT have to plan these diversions and coordinate these with the bus operators and members of the LSTCC. They may also need to deploy mobile staff to make additional checks on the diversion and take appropriate actions at the scene (e.g. putting up temporary signage on bus stops and roads). There are typically four members of the NRT team at any one time.

In this study, we draw on fieldwork undertaken in the site that included extensive field observation, audio-visual recording of the everyday operation of the service, and interviews and conversations with staff. In all, 60 hours of video-recordings were gathered in the setting. The analysis draws on ethnomethodology and conversation analysis and is concerned with the 'details' of system use, such as, for example, the entering of commands and reading text off screens. Although naturalistic, and involving extensive fieldwork, it is primarily based on the fine-grained analysis of human conduct. It necessarily demands the use of video recordings of system use, including in some cases, cameras capturing the 'users' and their relevant operations and the various displays of the system. At times, we collected recordings from four cameras simultaneously. We also had access to recordings of the radio and phone calls made by the staff we were recording. The approach we report here is primarily concerned with explicating the community of practice and procedure, the social organization on which participants rely in the production and intelligibility of action and activity and hence concerned with the social-interactional character of workplace activities.

## 4. ASSEMBLING ACCOUNTS: THE INCIDENT LOG

Unlike in many control and operation rooms, staff are primarily involved in undertaking specific, independent tasks that can be unrelated to the activities in which others, at any moment in time, are involved. It is relatively unusual, for example, for personnel within the control center to have a common focus of attention, and even where they are concerned in various ways with the same incident, elements of its management will be undertaken by different personnel, not infrequently at different junctures within the course of its development. This independence, yet interdependence of task and responsibility, is enabled through the technologies that are used to manage and coordinate the response to incidents and events. Each controller is positioned at a workstation along a series of back-to-back desks (see Figure 3). Each workstation consists of a bank of five screens, a telephone system, a keyboard, and a mouse. Unlike many other control centers, there are no large-scale screens or

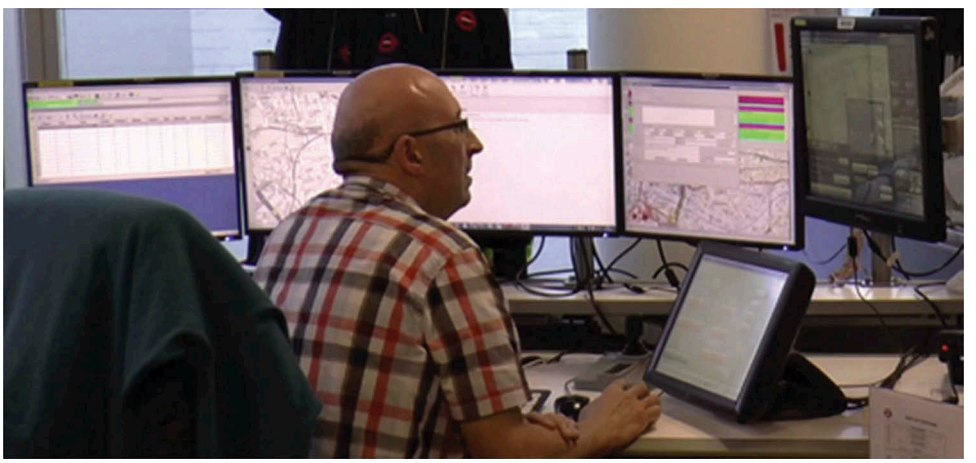
information diagrams that display, for example, traffic flow, incidents, or management interventions. There are a relatively few information or spatial resources through which personnel at any one moment are able to draw upon to have a sense of the current activity of a colleague.

The distribution of activities and responsibilities also stands in contrast to many of the control and operation centers addressed by research within HCI and CSCW. There is no formal division of labor between those working within a particular bank of desks. Each controller works largely independently taking calls and managing incidents when they arise, and while particular events may require support from other services, the controllers in particular areas do not necessarily comanage, at least simultaneously, an event or incident.

Personnel have a variety of applications to assist with the identification and management of incident events. These include, for example, systems that enable personnel to locate buses within the complex geographical region of London, to access relevant CCTV cameras and view multiple images at any one time, and a touch-sensitive display for taking and making radio and telephone calls. One application in particular is critical to the production and coordination of tasks within the center, namely the 'Incidents Log.' It is the principal resource through which staff manage and develop a coordinated response to incidents and events.

Incidents are typically initiated by bus drivers. When drivers require some sort of assistance, they press a button on their bus console. This is either a 'Code Red,' for

**FIGURE 3. A typical workstation for a member of CentreComm staff (NRT team). In front, he has a bank of five screens showing, from left to right, the incident log, a mapping system that automatically shows bus locations relating to the current incident, a screen with details of the current incident, another mapping system, and a display to show CCTV images. Also lower to his right is the computer-aided phone system.**

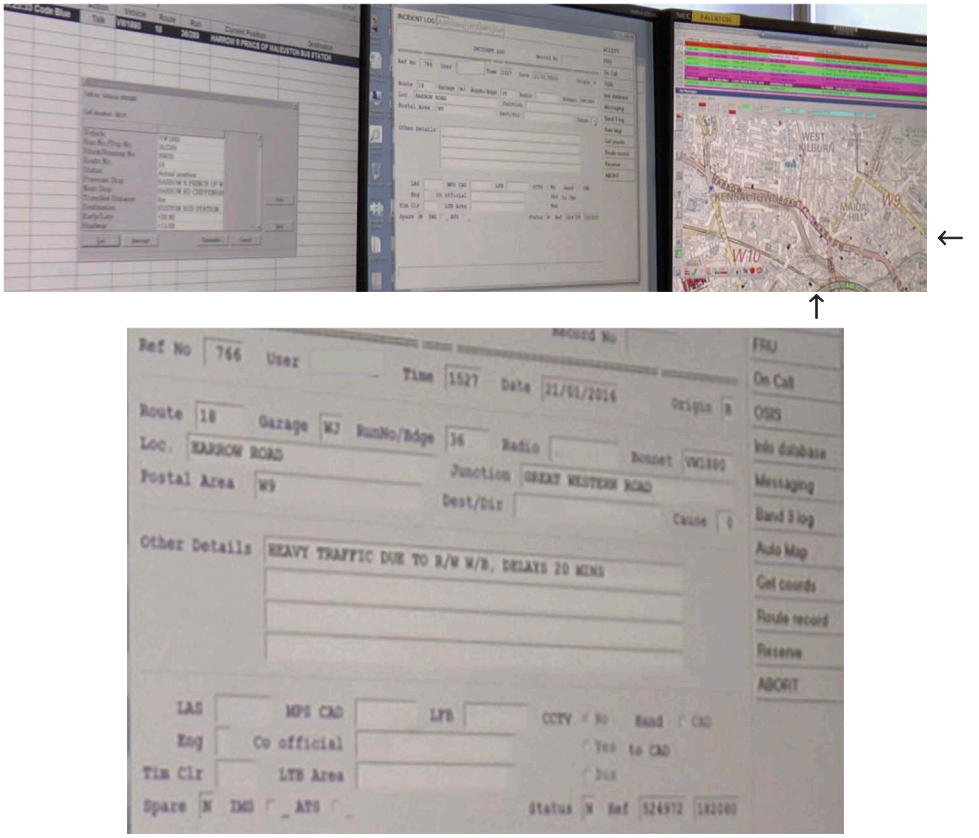


emergencies (e.g. when there has been an accident or where there is danger from a potentially violent passenger), or a 'Code Blue,' for incidents that need to be reported (e.g. extended delays, burst water mains, or traffic lights that appear not to be working properly). When the button is pressed, a loud audible signal (similar to the sound of smashing glass) is heard in the control room (audible throughout the ERT and NRT zones). A brief one-line summary of the incoming call (bus identifier, time, location) is also displayed in a window displaying an Incidents List. All controllers in CentreComm have access to this Incidents List. The members of the ERT team are those responsible for responding first. At busy times, there can be several incidents requiring a response, so they usually dedicate one monitor to the Incidents List (see Figure 4). The ERT controllers can select for themselves which one to take. Their next action would typically be to call the driver back.

There is a great variety of different kinds of events and incidents to be reported. Drivers inform the controllers of traffic accidents involving their bus or ones they have seen that might require some intervention, say from the police. They report incidents involving passengers, ones who are becoming abusive, are ill, or seem to be lost or separated from a carer. They also complain about problems with traffic lights, blockages to the traffic flow, and vehicles parking illegally in bus stops. Some of these are regular occurrences and some rarer. The details of the call are critical for others to recover both the nature of an incident and any response undertaken or required. Controllers need to record the details of the call and any actions taken. These are typed into an Incidents Log, and each record consists of a mixture of abbreviations, technical terms, and free text. Some items are automatically recorded (e.g. the bus route and bus identification), others can be selected from menus (e.g. the names of streets), and for others, information needs to typed in, most notably details about the call.

Figure 4 provides an example of an incident as it is being recorded. The driver has signaled a Code Blue and the alarm has sounded. When this incident is selected by one of the ERT controllers, a further window appears showing more information including a more precise ('actual') location, the bus's next scheduled stop and destination, and the current delay to the schedule ('20 minutes 40 seconds'). To assist the ERT controller, a mapping system shows the location of the bus signaling the incident. As in most cases when dealing with an incident, the controller calls the person reporting it through a computerized radio-phone system. The driver comments on the delay he is experiencing. As he does this, the controller starts to fill in the incident log. In this case, the incident is near a junction of one of the major roads in North West London, the Great Western Road. After taking the call, the controller completes the location details and then types in the details of the call. They record the nature of the incident reported by the caller (e.g. 'HEAVY TRAFFIC'), the reason for the problem (it is due to roadworks – 'R/W' – and effects westbound – 'W/B' traffic), and any consequences or actions that have been taken ('DELAYS 20 MINS'). In this case, as the delay is over the 20-min threshold, CentreComm needs to take action to reduce the delays. This is a case – if it persists – where NRT controllers would need to consider taking some action, like putting a diversion in place to reduce

**FIGURE 4.** ***Above*****: anonymised image of three of screens available to a member of the Emergency Response Team when an incident is reported by a bus driver. The screen on the left gives details of the call (a lesser 'Code Blue' incident) and the driver (e.g. location, route, delay). On the central screen is the Incident Log use for recording details of a call. The screen on the left can be set to automatically display the location of the bus in the call on a map – the bus is shown as a blue dot pointed to by the arrows.** ***Below*****: the incident log in more detail.**




the delays. The textual note therefore makes this noticeable for others in Centre-Comm, NRT controllers sitting at the next desk.

The controller's report is typical of an incident description. It is an entry that is written as 'free text.' Staff have great flexibility in how they write the incident reports and the contents vary greatly. Despite their variety, these descriptions follow a common format. They consist of a brief summary of what has been reported in the call, followed by the actions taken or the consequences of the incident. These entries can be very brief, such as the following:

**1. HEAVY TRAFFIC S/B 5 MIN DELAYS**

**2. HEAVY TRAFFIC S/B/SHEER WEIGHT OF TRAFFIC 10 MIN DELAYS**

In these cases, no immediate action can be taken by the controller, or none is required by a colleague. In others, the action can be minimal, and all that is recorded is what is reported by the driver or the response of the controller:

**3. FALL ON BUS DUE TO HEAVY BREAKING LAS DECLINED**
**4. BLOCKED BUS STOP. DRV ASKING IF HE SHOULD SERVE STOP – NO**

There are cases when these descriptions are longer and contain more formal elements. For example, after a 'Code Red,' an ERT controller, Michael, types the following:

**5. RTC PI 2x CAR LAS AND MPS ON SCENE. DOWN TO ONE LANE E/B**

(*a Road Traffic Incident between two cars and involving personal injury. London Ambulance and the Metropolitan Police are at the location. Eastbound Traffic is reduced to only one lane*).

Some elements of this description are drawn from a glossary of standard police abbreviations ('PI', 'RTC'), but others are transformed from what Michael has elicited from his conversation with the driver – that the police ('MPS' Metropolitan Police Service) and ambulance service ('LAS' London Ambulance Service) are attending and this has resulted in traffic restrictions. After recording these details, Michael tries to locate a CCTV camera on which to view the scene and assess the nature of the incident – none seems to be appropriate. He also calls the police to confirm that they are aware of this incident: the police who are in the same control room – sitting a few desks down from where he is located. He adds to the description: 'NO CCTV COVERAGE. AWARE SEE REF 605.'

This description is designed to be relevant to others in the control room. It is frequently the case, particularly with serious incidents, that many drivers and other members of staff report the same problem. Thus, an additional 'Code Red' may come in from another bus driver who has seen the same accident. The description indicates that along with the emergency services being on the scene – the police controllers are aware of the incident (by including the police reference number in the description). 'NO CCTV COVERAGE' is designed for other controllers: saving them time trying to view the incident using the CCTV system. Besides being a bureaucratic record to account for what has been said and done, if needed, at a later date, these descriptions are also a resource for collaboration and communication within the control room. They are succinct so they can be read quickly by colleagues. They are designed in the light of the envisaged circumstances colleagues will face when encountering the incident later or trying to resolve its consequences.

In some cases, the implications of an incident, and hence any actions that need to be taken by a controller or colleagues, are not clear, as in the case of an adult who has been lost.

**6. MALE 79 WITH DEMENTIA WAS LEFT OUTSIDE A SHOP FOR 10 SECS AND WHEN PERSON CAME OUT. THE OLD MAN WAS MISSING TOLD DVR TO TELL PERSON TO CALL POLICE IMMEDIATELY**

Here, a driver has informed the controller what he has been told by a passerby while waiting at a bus stop. The description of the incident is written as a near-verbatim report of what the driver was told. This incident has little consequence for the staff dealing with traffic within the control room. The report is produced for organizational purposes; it records that an appropriate response to an incident has been undertaken so that if required at some later date those reading it can get a sense of what was reported, what information staff had access to, and what they did in response. The report records accountable actions and responses.

As some incidents take some time to resolve, a number of calls will be recorded on the system. These may involve contributions from several controllers. Therefore, in the following case, initially (at 13:13) a controller takes a call from a driver who reports an accident on their bus. The controller then contacts the ambulance service and records the ambulance service reference number and details of the call.

**7.1 55/60 YRS OLD FEMALE FELL WHEN GETTING OFF BUS. BUS NOT MOVING. FACE INJURY AND IS BLEEDING FROM MOUTH. A&C ALERT, BLOODY HEAVY**.

Just over 10 min later, the driver calls back and another controller takes that call adding an additional note:

**7.2 NFDS*13:25 DVR ENQ ETA LAS**

*(referencing the previous call, 'Driver enquiring estimated time of arrival of London Ambulance Service')*

Nearly an hour later, the driver calls again reporting that the ambulance service has arrived, attended to the patient, and the bus now is on its way. A third controller takes this call and makes an additional note.

**7.3 1429 DRV RECALL. LAS ARRIVED, CLEAR**

The descriptions do not just summarize what has been reported by a member of staff. Often the nature of the incident requires the controller to make sense of the event to assess what kind of response is required. In the following, a driver signals a Code Blue at 14:40. The controller calls back immediately and the driver reports a lorry obstructing a junction. After closing the call, the controller enters the following into the system:

**8. LORRY PARKED UNLOADING AT JUNCTION. PASSABLE WITH C&C**

This description reflects what he has elicited from the driver, that the obstruction can be passed with 'care and caution.' Before submitting the report, the controller checks by locating a CCTV camera of the region and panning across the junction. There seems to be little to cause a blockage. He then adds 'CLEAR ON CCTV 1442' to record his assessment of the situation, which, in the two minutes that has elapsed since taking the call, has changed.

As in many of the calls, it can be problematic to identify the precise location to be recorded. The location of the caller, that of the incident, and any places that might be effected by the incident may all be different. In the following case, a driver calls in to report a fire that has resulted in a road being closed. The driver initiates his call with a report: 'there's a fi:re (on) erm (0,2) Queens Park (0.2) by errm Victoria Road (.) by the library.' The system identifies the location of the bus as being on Salusbury Road. The former location reported by the driver ('Queens Park') is the general area and also the name of the bus stop. The latter location reported by the driver ('Victoria') is the name of a road leading onto Salusbury Road. In this case, later in the call it emerges that the fire is at Kilburn Library (just south of Victoria Road) on Salusbury Road and it is Salusbury Road that is closed. At the end of the call, the controller enters the location as 'SALUSBURY ROAD' and the 'JUNCTION' being 'VICTORIA ROAD' with the description:

**9. LIBRARY ON FIRE – LFB HAVE CLOSED ROAD**

*('LFB': London Fire Brigade*).

With these precise descriptions, an ERT controller records their assessment of the nature of the incident that the fire is significant and a major road – Salusbury Road – has been closed in both directions. This will require an NRT to set up a diversion along this route.

Although the Incidents Log is a system for recording incidents, it is also a resource for communication and collaboration within the control room. Other staff do not just need to access the record at some future date, but may require it for their concurrent management of the same incident or a related one. Therefore, in constructing a record of an incident, staff are sensitive to the needs of colleagues both within the control room and elsewhere. There is an economy of description in how they are written. As they need to be read quickly, they are written succinctly so that the nature of the incident and any action taken or response made are clear. Hence, as in (9), the location and the nature of the incident have consequences for how it should be managed. A minor fire in a litterbin on a side street requires a different intervention from a fire in a building on a major road. The controllers need to be able to make sense of locations with regard to their consequences, and draw from their experience, of routes through London and traffic flows, to assess the incident and record it in such a way for colleagues. An initially vague description from a driver ('a fire by the library') is

transformed into a succinct and more precise description for others, namely staff in the NRT team, in the control room.

In some cases the nature of the incident and hence any response are unclear. In the following, a call comes from the Metropolitan Police reporting a 'puddle' of cement at a road junction on a major road (the Highway with Dock Road) in the East of the City. The Highway is a 'Red Route:' one of the roads that are critical for the flow of traffic in London. These are major bus routes and other traffic is not permitted to stop on them. As the incident is likely to cause problems for traffic until it is cleared up, the controller taking the call (Michael) uses the CCTV system to try and assess the nature of the spillage. Using a camera that he can operate (number 2351), Michael pans and zooms around the junction and along several of the adjoining roads.

**Illustrated Transcript 1**

M selects camera from CCTV map display

M pans East up 'The Highway'

M pans West down The Highway' to the junction with 'Dock Street' and then South then North across Dock Street

There is heavy traffic, but this seems to be moving in most directions. Michael then makes a broadcast radio call to all drivers in the ('E1') area warning them of what he has been told by the police: there has been a 'cement spillage, quite a large spillage' at the junction between 'Dock Street' and 'The Highway.' Michael records the call as his response as:

**10. WET CEMENT SPILLAGE - C/C CALL MADE CANNOT SEE ON CCTV 2351**

Here again, there is a report of the incident followed by the action(s) taken: a closed circuit call has been made to drivers. An additional note is added: that the problem is not visible through the CCTV system. Michael adds the number of the closest camera to the incident that he tried. Taken as a whole, his description reflects the rather ambivalent nature of his assessment of the incident.

Controllers in the large control room draw on a range of practices to communicate with others through the Incident Logs. They write descriptions in a standard format, adopting a formal (and semiformal) glossary of terms. They display their assessment of the nature of an incident and its severity. They draw on their knowledge of locations and routes to transform what they have been informed of into descriptions that are relevant to their colleagues in the control room. The descriptions are written not just for the possibility that they be of relevance at some unanticipated time in the future by others within the organization, but also for more immediate concerns of colleagues: a member of the same team taking a call about the same

incident, or for a member of another team to follow up and try to resolve the problem. As such, they are a resource for copresent collaboration.

Besides serving as a means for communication, controllers also maintain the bureaucratic nature of the logs, as records of incidents that have been appropriately noted and responded to. The records are therefore written to meet dual demands: to display retrospectively that a 'reasonable' response has been produced and prospectively for staff to be able to draw on the record to take further appropriate actions. These records need to be succinct and yet provide resources for others to assemble a sense of the nature of the incident and how to subsequently deal with it. Thus, just a note of a police or ambulance number will reflect that the other organization has been informed, a series of abbreviations will display that appropriate information has been elicited, and more open descriptions can display the ambivalence of what is being reported and potential problems with its management. Although the Incident Log is in many ways a conventional information system – recording data of different kinds about related incidents and events – it serves as a resource for collaboration and coordination within the teams working in the same area.

Perhaps more consequentially as there is no *a priori* division of responsibilities for taking particular kinds of calls, say in terms of region, severity, or nature, calls related to an incident and follow-up calls can be taken by any member of the team. It is therefore hard, even if something of relevance is overheard, to tie events and incidents to particular individuals and their responsibilities. It can also be difficult to assess who may be a suitable recipient for a new piece of information. Activities are more fragmented and hence a computer system becomes a, probably the, principal means for communicating what has occurred and how it is being responded to: a resource for the management of ongoing incidents. Hence, a system not designed to support colocated activities, one that is more focused on supporting asynchronous and remote collaboration, becomes a critical resource for coordination and cooperation within the same space. A range of practices have emerged for producing the entries into the system so they still serve as an organizational record but also inform others in the control room about ongoing incidents. They are a resource for displaying that the appropriate action has been taken and for making visible the warrant for the actions that has been taken. They are designed for recipients and readers (cf. Sacks, Schegloff, & Jefferson, 1974) who may be unknown and read at some unspecified time in the future. The contents of these records are accountable.

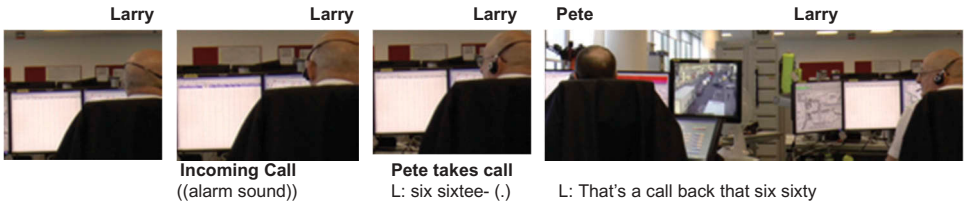
The reports are written with regard to multiple, prospective relevancies for colleagues who share the same space so they can take further related actions. Writing the records therefore requires careful crafting, to be made sense of as a retrospective account of what has been done and a prospective resource for colleagues. They also have to be written with a certain economy of description so colleagues can make sense of them as they are trying to respond to incidents. The report of an incident enables the reader to gain an overall sense of what it is (and with related information, where it happened), its potential importance, and any response that has been taken – how it is being currently managed. Perhaps, most critically the descriptions provide the resources for enabling and even occasioning action by others. At times, this may require the writer to leave certain matters open and vague, and, as we will see, this this may require intervention by colleagues and engender other forms of collaboration.

## 5. COPRODUCING COHERENT ACTION: RECONSTITUTING THE FACTS

Although several controllers may contribute to an entry in the Incident Log at different times, the system is typically used and viewed by one person at any one time. There are occasions however in which it proves necessary to contribute to, or intervene in, the management of an incident currently undertaken by a colleague. Consider the following fragment where Larry notices that Pete sitting to his left (see Figure 5) is taking a call that appears related to an incident he recorded some time back.

On hearing the audible alarm signaling a new incident, Larry looks at the 'Incidents List' on his monitor (second from the left of the bank of six screens in front of him). As the line disappears, he utters 'six sixtee' – the route number of the driver making the call, Larry then turns to Pete saying 'that's a call back that six sixty.

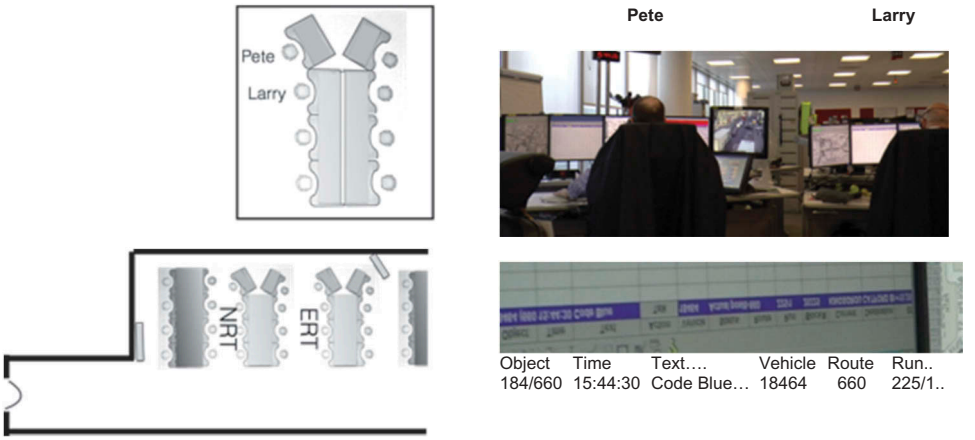
**Illustrated Transcript 2**




Although not oriented to Pete, Larry, from Pete's conduct (his left hand moving toward the keyboard and right toward the mouse), and then the related disappearance of the incident from the list waiting to be responded to, identifies Pete as the member of the team taking the call. Besides informing Pete that this is a follow-on call, Larry makes it apparent that he was the one who took the original call. He also gives Pete a brief summary of the incident: 'kids grafitteeing the upper deck with a spray can.' As he says this, Pete displays the record of the call on one of his screens. The written record contains a very similar description to that which Larry wrote some 20 min earlier: 'GROUP OF KIDS ON UPPER DECK SPRAY PAINTING' (see Figure 6). It also has an MPS code filled in. This indicates that Larry deemed the incident severe enough to call the police. The bus is stationary, waiting for the police to arrive.

Larry turns back to his bank of monitors while Pete takes the call. As Pete talks to the driver, it emerges that the incident seems to be different from what has been reported. The initial statement from the driver is quite long (over 20 seconds). While the driver is speaking, Pete shakes his head and says to the driver: 'No (.) Haven't they been spraying on the top deck of the bus over?' This reveals some problems between the driver's account and what Larry has said and recorded about the incident. Pete's talk is designed not just for the driver, but for Larry, who has now

**FIGURE 5. On the left is a diagram of the CentreComm area of the London STTOC. Bottom left is the entire section and top left is a detail showing the location of the participants (Pete and Larry) featured in Fragment 1. On the top right is an image from the video recording taken from behind Pete and Larry's desk and below right is the line from the Incidents List, which appears when the call in Fragment 1 comes in.**

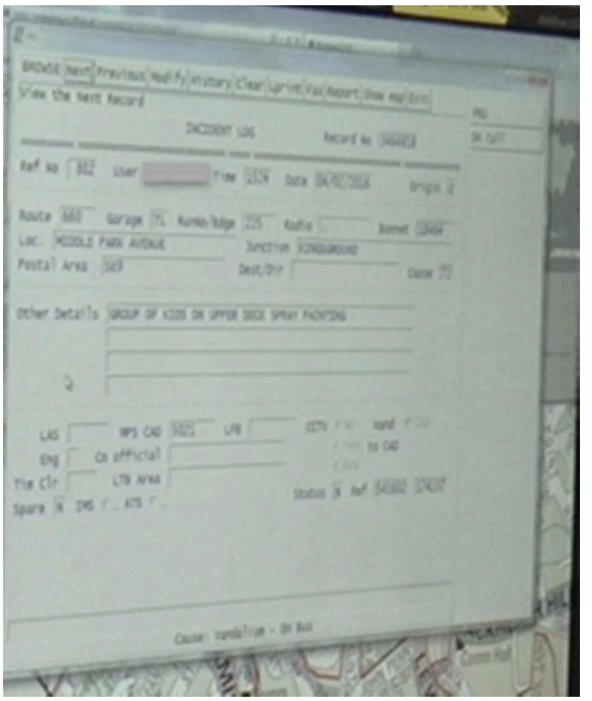



turned back to Pete. Like all calls that are taken, the remote party's talk (the driver's) is inaudible to anyone else in the control room.

**Fragment 1: Transcript 1 – Control Room**

((Alert sound))
(1.4)
L: six sixtee- (.) That's a call back that six sixty
(0.6)
P: two two five six sixty go ahead
(1.5)
L: yes some kids been spraying the upper deck with a spray can
(23.5)
P: No (.) Haven't they been spraying on the top deck of the bus over?
(.)
L: that's what he told me
(13.7)
P: No you wait for the police because they have damaged London Busses property over?
(21.7)
P: But if it is not a paint spray what is it over?
(0.2)
P: (sticky) glue spray glue

**FIGURE 6. The window showing the incident log for the prior call.**



(.)
L: same thing innit (0.8) criminal damage
(6.8)
P: what where you spray it and its like a big long (.) string comes out of it over.….
(0.7)
L: not a glue is it silly string, silly string, like silly driver
…
P: yeah I'll er cancel the police over.,….

Throughout Pete's call with the driver, Larry makes contributions about the original call and what should be done. Pete has to manage two sets of demands: one placed on him by the remote participant – the driver – and the other by his copresent colleague. Pete's 'No (.) Haven't they been spraying on the top deck of the bus over?' draws on what he has been told by Larry ('kids grafitteeing the upper deck with a spray can') and what he can read from Larry's report ('Group of Kids on upper deck spray painting') and displays to Larry he is aware of these. It also reveals to Larry some problem, which Larry attends to in his confirmation to Pete that follows: 'that's what he told me.' Pete then reiterates to the driver the current course of action involving police intervention, set in place by Larry: 'No you

wait for the police because they have damaged London Busses property over?' When further details emerge from the driver, Pete repeats these in his response. These details serve as a confirmation to the driver and inform Larry of the change: that it appears the perpetrators are not spraying paint but glue. Larry reaffirms that this still is a ('criminal') problem and still requires police action.

After hearing the driver's next contribution, Pete responds with an utterance that also informs Larry of a contrast with what has previously been reported and recorded: while shaking his head, he says: 'what where you spray it and its like a big long (.) string comes out of it.' Larry comments on the change in what has been reported; the substance involved seems to be neither paint nor glue, but string spray (of the kind used in parties). This is not such a serious incident, and when Pete gets a confirmation from the driver, he cancels the request for police intervention.

Throughout this call, Pete, while responding to the driver, is also informing Larry of what is being reported in the call. Each of his utterances is doing a 'double duty' (cf. Turner, 1970). Indeed, his utterances also display to Larry (and the driver) his stance to the incident: a 'triple' duty. At first, he reiterates features of the original report, warranting the course of action in place. Later, as new details emerge from the driver, he repeats the details of what he has been told in such a way to mark the change in his assessment of the seriousness of the incident. Larry recognizes this, repeating this information while also remarking on the driver who made the original report.

For Pete to accomplish these multiple activities through talk, he has to transform what he is being told by the driver for the benefit of Larry while also managing to accomplish a coherent conversation with the driver (see Transcript 2).

For example, when the driver provides some extra information about the incident, that he has confiscated the spray and repeating that the perpetrators have 'promised that they will now "behave themselves,"' Pete's utterance reflects that he has heard this, but reiterates that it does not change the action required: damage has been caused and this requires the police. This seems to induce the driver to inform the controller that the substance 'is not causing any damage' and that one of the perpetrators ('the child') says 'its like a paint spray but not a paint spray.' Pete then seeks clarification through a question that also indicates a potential change of state in his assessment of the incident: 'But if it is not a paint spray what is it over?' The driver's response to this informs the controller more about the nature of the actual substance '(wacky) string,' which Pete conveys to Larry in his response 'you spray it and its like a big long string comes out' – accompanying this with a gesture suggesting how the sprayed string works.

In previous studies of centers of coordination personnel could sensitively monitor their colleagues peripherally. This was in part because of the common resources that could be assumed available. In London Underground and Dockland Light Railway, screens and displays provided a visible picture of the state of the entire service. These provided the background for colleagues to make sense of emerging

**Transcript 3**

| **Fragment 1: Transcript 2** | |
|---|---|
| ***Only audible to Pete and Driver*** | ***Only audible to Pete and Larry*** |
| **((Crash sound))** | |
| (1.9) | L: six sixtee- (.) That's a call back that six sixty<br>(0.6) |
| **P: two two five six sixty go ahead** | |
| (3.2) | (1.5)<br>L: yes some kids been spraying the upper deck with a spray can |
| D: (( noise )) he- he- er yeah its err (0.2) two two five calling err: I have spoken to (the)are children and they now saying that they are sorry and they are not going to misbehave again? (.) err the police didn't arrive yet (0.3) so err: (.) er: (.) er: (.) I decide that if you know its okay with you to er carry on<br>(0.3) | |
| **P: No (.) Haven't they been spraying on the top deck of the bus over?** | |
| | (.)<br>L: that's what he told me<br>(0.6) |
| D: (but er ) like a sticky thing that were spraying but they er now do need a spray. I I confiscated er the spray? (.) and err they promised not er they gonner you know behave themselves.<br>(.) | |
| **P: No you wait for the police because they have damaged London Busses property over?**<br>**(0.6)** | |
| D: (he he) ((Noise)) actually it- its like something sticky er its is- not causing any damage to the bus er () so er: the child (would) pass it to me at first hand and says to me oh its like a paint spray but its (not) a paint spray ((noise))<br>(0.2) | |
| **P: But if it is not a paint spray what is it over?**<br>**(0.2)** | |
| D: ( er some) thing sticky err (0.2) er its' (seems it) string err (wacky) string its – its something like a like a chewing gum.<br>((noise))<br>(.) | P: (sticky) glue spray glue<br>(.)<br>L: same thing innit (0.8) criminal damage |
| **P: what where you spray it and its like a big long (.) <u>string</u> comes out of it over** | |
| D: (yeah the the children) have moved it – removed it from the bus<br>…. | L: not a glue is it silly string, silly string, like silly driver |
| **P: yeah I'll er cancel the police over.,….** | |
| ((Pete calls police)) | P: they have given him a tin he has spoken to them and they have apologized – yeah =<br>L: =that's fair enough isn't it<br>… |
| Police: (hello busses how can I help)<br>(.)<br>P: hello there I have a cancellation for you and your reference is five zero two one?<br>… | |

incidents and events handled by others. Moreover, as the stream of incoming calls taken by a controller was broadcast through a speaker, others could draw on this to monitor the call in progress. Staff handling the incidents could then rely on others being 'aware' of incidents and how they were being managed as they emerged. In the

multicenter control room, such semipublic resources are no longer available. If nearby colleagues do collaborate on the fine details of managing an incident, they need to make features of the call accessible to those colleagues. Thus, in the case discussed above, Pete has to manage two sets of demands while taking the call: one placed on him by the remote participant – the driver – and the other by his copresent colleague; Pete has to be sensitive to the concerns of both co-interactants. On the one hand, Pete has to deal with the driver who is suggesting that the situation has changed and that the bus should be able to proceed on its way. On the other, he has to be sensitive to his colleague, Larry, about changing the course of action that Larry has set in place. The response has to be an appropriate one on behalf of the organization. Pete therefore repeats key details of the call and neglects others (like the 'chewing gum' nature of the substance, or the matter that the children have promised not to misbehave again). Larry's intervention that it is 'still criminal damage' occurs just as it becomes apparent from the driver that the substance is innocuous. Thus, Pete's work in determining the exact nature of the substance is as much for Larry – to provide an account for a change in response – as it is for the driver to clarify what the substance is. Indeed, what becomes apparent to both controllers is that in his initial report the driver had limited information about what had occurred on the bus. Only once the bus had been held for some time do details of the incident become apparent. Larry's 'silly driver' then seems to be as much about the driver acting precipitously, than about his abilities or capabilities. Pete then has to manage questions about the competence of the driver as well as dealing with a change in managing the response. Once the call is over, Pete tells Larry some of the actions the driver has taken to address the incident.

Larry's physical proximity makes it possible for him to contribute to Pete's management of the incident. He can provide a summary of the incident prior to the call and offer advice on its management. However, because he has no access to the real-time production of the call, Larry's cooperation requires Pete to design his talk on the radio not just for the primary recipient – the driver – but also for his copresent colleague. Handling these dual concerns of a remote party and a copresent colleague can thus be disruptive. Pete has to transform his utterances so Larry can not only get a sense of what the remote participant is saying, but also why it is consequential. Because of the asymmetrical nature of the resources available, Pete needs to be sensitive to the differing kinds of accessibility each of his co-interactants has to those resources, and manage a distribution of information to a colleague sitting next to him and a participant many miles away.

In these multicenter control rooms, staff have a wider range of technologies available to them than in those reported in previous control room studies. However, staff cannot rely on a common background made available through some public resource to facilitate collaboration. Hence, they need to reconstitute details of what has happened, alongside what is emerging and others' stance toward these. They need to make public what was private, but also what in smaller spaces was accessible. Staff do, on occasions, volunteer information to copresent colleagues by shouting brief descriptions out loud to colleagues. These may report a new incident on a major road that may have major knock-on

consequences (e.g. 'Green Street Closed') or a change in status of a previously reported incident (e.g. 'Albion Road Clear,' 'Gubbins Lane Passable,' 'on the move at Whitehall'), or check whether an incident has already been reported (e.g. 'anyone have Town Hall Approach?', 'anyone got Salusbury Road?'). These usually serve to work alongside the Incidents Log – to check whether it has been recorded, report that it has, or to note its status has changed. These 'outlouds' rarely engender the more focused or extensive forms of collaboration we find in smaller control rooms.

It is not just the scale of the environment that makes the forms of 'micro-collaboration' found in smaller control rooms less prevalent, but also the transformation of the ways in which work is organized. Staff in a local space within the large control room have very similar responsibilities and undertake those activities in parallel. Colleagues can no longer rely on those responsibilities to assess what someone else might be doing, what they might find relevant at this time, and how it might be consequential. Fine detailed collaboration then only seems to be engendered by happenstance, as when a colleague happens to be sitting next to another and not engaged in some other task. Although such interventions can provide support, they can also be disruptive, or at least copresent collaboration becomes another demand that needs to be managed. The large space and the way tasks are distributed around it, rather than facilitating copresent collaboration, seem to require remote and asynchronous forms of communication.

## 6. REFINING TEXTS: MEDIATING DESCRIPTIONS ACROSS ORGANIZATIONAL BOUNDARIES

As may have been noted, in most of the incidents considered above, it is very common for these to require contributions from the different organizations within the control room. The most serious incidents either are reported by the police or need to be reported to the police, and many of the major diversions require interventions from those managing street traffic. Despite being in the same physical space, these different organizations each have their own information systems and recording systems. Partly this is for historic reasons, and partly because of the quite different requirements of the different organizations, particularly in the case of the police and the legal demands on their activities. Nevertheless, even though the information systems may be distinct, the entries are written with regard to the concerns of the other organizations. When a member of staff from one team informs a member of a different organization about an incident, they inform them of their reference number for that incident. These are then entered into the other's systems and it provides a way of tying the records together. Again, this is for bureaucratic purposes, but they can also assist staff when someone calls back about an incident. Controllers also make notes to assist colleagues in the same team to

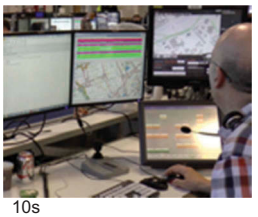
manage an incident. Thus, noting that police have been informed of an incident implies that if the incident is resolved, they should be informed of that as well. The records in the Incidents Log therefore serve as a record of communications across organizational boundaries and a means of managing those communications. And yet, staff in the different organizations within the control room have limited access to what others in different organizations are involved in. They also know little about the work and the ways other organizations manage incidents they have recorded.

As mentioned above, the Incidents Log also serves as a means of communicating between the sub-teams of CentreComm. Members of the NRT look through the Log to select from those incidents reported by members of the ERT. They select those that require longer-term action, such as planning a diversion to circumvent a problem. There is an organizational requirement that CentreComm take some action if delays are more than 20 min. Some problems, major incidents like serious vehicle accidents, fires, or demonstrations, may take hours to resolve and any diversions are temporary. Others, involving roadworks and blockages to the roads, can involve interventions lasting several days.

Arranging a diversion is a complex process involving finding an alternative route that misses the fewest numbers of stops while still being passable by buses. This may require changing information on electronic signs and even putting in place temporary signage. In turn, a team may need to be sent to the site to survey details of roads that have not been used before, or have changed since their last use, and to put in place that temporary signage. When the diversion has been planned, the NRT team then has to inform any drivers immediately effected and other control rooms, most notably those in the bus stations that send out the buses. The information is also passed onto another team that informs the public of the change (through a web page and other kinds of social media alerts). Diversions can also require changes to traffic regulations. This may involve the changing of the phasing of traffic lights to improve traffic flow, changing the lanes buses can travel on, and even allowing traffic to go in directions or make turns they are not usually allowed to do. Making these changes is the responsibility of the LSTCC, who are also located in the Operations Centre. LSTCC also are responsible for maintaining traffic flow through the key routes through London – known as the Red Routes. They are responsible for clearing any blockages on these.

In the following fragment, one of the NRTs, Robert, selects an incident from the log. It is the one the ERT controller (Michael) entered about the cement spillage (see 10 above) with the description: 'WET CEMENT SPILLAGE - C/C CALL MADE CANNOT SEE ON CCTV 2351.' Michael had had problems assessing the nature of the incident and recorded this in the log. A cement spillage along one of the major routes of London might require a diversion or some other form of intervention such as restricted usage of any lanes the spillage covers.

**Illustrated Transcript 4**

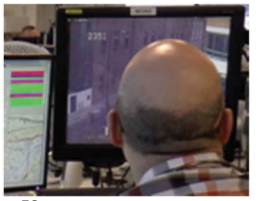


10s

R selects top incident (in red) from incident list on the monitor second from the right

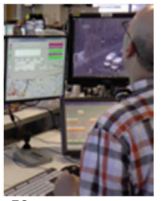
20s

R selects the camera map and after scrolling around the map, selects camera 2351 (the log description is on the left of the left display)



52s

R views junction



53s

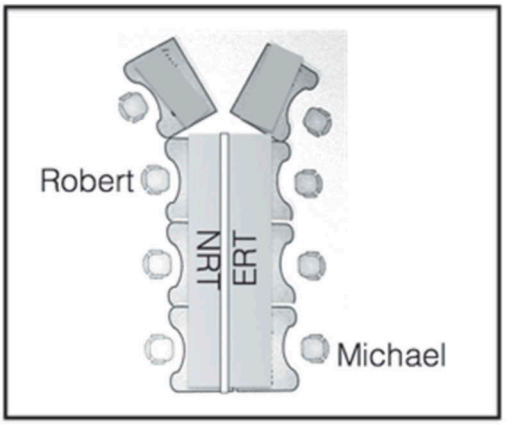
R looks above monitor towards Michael

Robert selects the camera noted by Michael in the log. Half a second after the image appears on the screen, Robert sits back and looks over his monitor toward the ERT team. Robert then stands up, looks around the ERT zone, and then calls out to Michael.

**Illustrated Transcript 5**

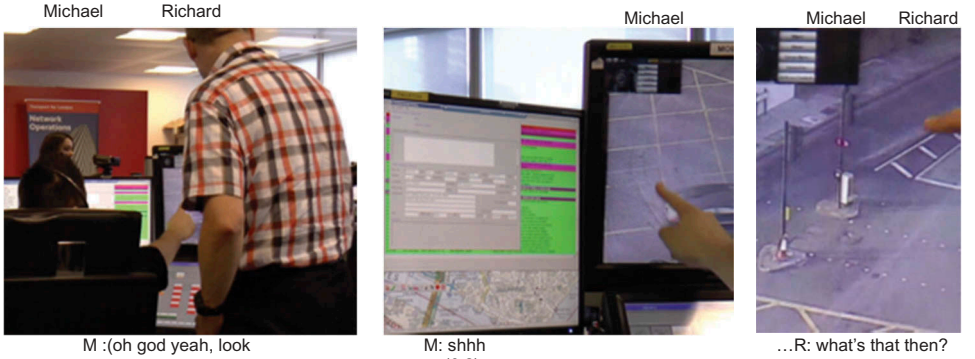
**Fragment 2: Transcript 1**

R: (Michael)?
(8.0)
R: (Michael)?
(0.5)
R: two three five one Dock Street?
(0.3)
M: yeah
(0.2)
R: you've got on there cannot see on Cee Cee Tee Vee
(0.1)
M: I could not see it
(0.1)
R: (what's that) large brown mark (I wonder what that is) sheh eh
(0.1)
M: Really?
(.)
R: if you look on the Nor- the Northbound ( )
(0.3)
M: hold on a minute




Robert appears to have found the problem on the image and, from the identification in the log, searches for the member of the ERT team (Michael) who entered it. Robert informs Michael who is engaged in other activities. When he completes these, Robert comes around to Michael's desk. Michael selects camera 2351 again.

**Illustrated Transcript 6**




Even viewing the screens again, Michael cannot find the spillage. When Michael pans the camera upward and then to the right, a brown mark becomes visible. Robert points to it, saying 'whats that then.' Michael's response to Robert provides some account of the problem he has faced. Referring to the original police call, he tells Robert: 'he said it was a puddle, I was looking for a puddle.' The appearance of the mark, although large, is not apparently wet. Robert is concerned about both the nature of the problem and its location: if it is wet, it could cause damage to vehicles; if it is dry, it could cause an obstruction. It is also on one of the Red Routes and it is the responsibility of the LSTCC to resolve. Michael has informed drivers of the incident but not the LSTCC.

Robert returns to his desk and goes on to call the LSTCC. This is located on the other side of the room. After the completion of the phone call, Robert amends the description; he adds the line 'LSTCC AWARE TLRN' – 'TLRN being the abbreviation for TfL London Road Network' (i.e. a 'Red Route').

The controllers have committed a lot of effort to the correct identification of this problem and the production of an accurate description for the record. This has involved staff from all three different organizations (and four teams) within the control center. The police initially reported the incident, the ERT team made an initial response and informed drivers, and the NRT team identified the nature of a solution that would be put in place by the LSTCC. Throughout their management of the incident, they draw on different descriptions and characterizations of the problem provided in different media and modes. Initially, the police provide a description in a phone call (giving a characterization as 'a puddle' accompanied by a location). This characterization is relevant for the management of traffic through the area and reflects its seriousness. Michael transforms this into a textual description in the log as 'Wet Cement Spillage' and completes fields giving the 'Location' as 'Dock Street' and the 'Junction' as 'The Highway:' a description that (formally) characterizes the

kind of incident, accompanying this with a note revealing some uncertainty as to its nature (recording that it cannot be independently assessed). Robert, when clarifying the problem to Michael, calls what he sees a 'brown mark' on the 'Northbound.' When Michael and Robert are viewing the screen together, the location and nature of the problem become apparent. When Robert calls the LSTCC by phone (where he refers to someone losing a 'load of concrete'), the description is designed for those responsible for clearing up the problem. While on the call, Robert and the member of LSTCC sitting elsewhere in the control center jointly view the same CCTV image to determine the location and nature of the problem – whether it is indeed on the Highway or on Dock Street (not a Red Route). In this discussion, they agree that this is not a matter for CentreComm to address; the NRT team does not need to plan an intervention. Instead, the location and nature of the incident require a response from LSTCC. This is reflected in the note that Robert adds to the log, which provides an account of why the LSTCC were informed and implies why it is their responsibility.

Previous studies of control centers have identified a number of practices through which call-takers integrate the talk produced in the call with the use of a technology for recording details of that call. They have noted how hearable features in the call can be assessed, interpreted, and classified when recording aspects of the caller (Whalen & Zimmerman, 1998), how the use of technology has to fit with the social organization of the call, and how the call may be shaped in ways to fit the demands of the system (Whalen, 1995a). The writing, or more accurately the typing, into the system is produced with regard to both the socio-interactional requirements of the conversation and the demands of the organization. In the large traffic control center, staff similarly have to draw from their talk on the phone and radio to produce a record that is relevant and appropriate for others, but in this case those others may not be from organizations with common concerns and requirements, but may have distinct interests and ways of utilizing the information that is recorded.

As in other kinds of records of work, textual descriptions are written for particular kinds of readers (Heath & Luff, 1996b). However, where these written records can be accessed by a large readership of participants from organizations with different concerns, it can be a challenge to design these texts so that the nature of an incident and the actions being taken are seen as relevant and appropriate. When reading the texts, participants assess not only the text's appropriateness to their own concerns – whether the report warrants a diversion, for example – but also its potential relevance for others – who else might need to be informed. This may require work to interpret the records and often discussion and clarification with those who originally wrote them.

In this and many other cases, the location and nature of a problem mean that a network of organizations and a complex chain of communications are required to manage the incident. The incident descriptions are critical in this regard. They provide an essential resource for assessing the importance of a problem, its nature, and what action has been taken by this part of the organization. The understanding of the textual account of a problem is made not only through what is written in the description: the location of the problem given in other fields, when it was reported,

and whether other organizations have been informed (indicated by reference numbers being entered). As with other features of the records, these elements are entered for colleagues, to show that the required organizational action has been taken or to facilitate them so that they can undertake a future one. However, despite having implications for others in other organizations, these descriptions are principally designed for those within one's own organization. If there are problems with them – they are vague, erroneous, or ambiguous, for example – a colleague can help refine them. As in the case above, a colleague makes use of them being in the same room to go to them to confirm the correct description of an event and the consequences for what to do next. When such a correction involves others in other organizations located in the control room, it is even less common to address problems 'face-to-face.' Indeed, in those cases where the issue is complex, staff more commonly use the phone to contact others in the same control room: the police frequently call members of the ERT to report serious incidents and *vice versa*, and members of the NRT and LSTCC call each other to talk about the relationships between diversions and changes to traffic flow. Nevertheless, it might be worth noting that when staff do make spoken intervention, whether 'face-to-face' or on the phone, these are typically with regard to the descriptions made in a log – to correct, clarify, or elaborate on them.

Despite being in the same physical location, the co-presence of staff does not seem to be fully exploited. The boundaries between the information systems and the ways they are used seem to reflect the boundaries between the organizations that occupy the same space. In part, this seems to be related to ways contributions are designed for the relevant audience and how responses of that audience are assessed. For colleagues for whom you can anticipate the relevance of your contribution and assess its potential relevance for them, even if this is just through a short piece of text, it is possible to design it in such a way to be read so the consequences can be made apparent. When little is known about the tasks and responsibilities of others, how in detail they undertake their work, then designing contributions with regard to their activities – either through text or within a conversation – is problematic. Hence, there may seem little value in being in the same space, and the most common way for staff to communicate with members of other teams is in much the same way as they did before they were collocated.

## 7. DISCUSSION

### 7.1. Collaboration in a Large, Multicenter Control Room

In this substantial control center staffed by more than 100 personnel, colocation is only occasionally critical for coordination and collaboration. Unlike many control and operation centers that rely on a range of socio-interactional practices to enable information and activities to be rendered selectively visible, personnel cannot necessarily depend on colleagues to remain sensitive to and aware of the emerging details and practicalities of the tasks in which they are engaged. The scale of the operation,

the division of labor, and the complex range of incidents and events, coupled with the systems used by personnel, encourage and enable a fragmentation of responsibility and task. Members of the ERT teams do make information available to colleagues both within the same team and to the nearby NRT team. They will leave their console to discuss incidents with colleagues and members of the other team. Typically, staff walk over to a colleague once they have completed their own tasks and often these discussions are with respect to something that has been reported in the log. However, notwithstanding the importance of the incident log as the anchor of coordination, participants within particular regions can be insensitive to the work and demands of colleagues. Staff may call out incidents they think of general relevance to colleagues, and these are typically designed to be understood with respect to an accompanying record in the Incidents Log. However, rather than being designed within junctures in another's activities, these 'outlouds' tend to be shouted after their own call. The subtle interactional practices that were revealed in smaller centers of coordination are not such a critical resource in the large control room, even between members of the same suborganization or team.

The management of the control room are aware of the challenges of trying to support collaboration within the multicenter control room. One of the objectives of collocating staff from these different organizations was so that a more coordinated response could be produced between the organizations involved. Indeed, when the control rooms were initially integrated, NRT were located in a much closer position to LSTCC. This aimed to encourage closer cooperation when dealing with longer-term incidents requiring traffic management. However, this configuration of the control room meant that the ERT and NRT were further apart, and hindered collaboration regarding bus traffic. A subsequent reorganization of the control center placed ERT and NRT in their current configuration, closer together, and more closely replicated the arrangement before the control rooms were colocated.

In such a large space, it seems problematic to envisage any spatial arrangement that could anticipate and facilitate all forms of potential collaboration. There are many types of relationships between activities that could be facilitated by locating staff closer together, and yet these would inevitably have consequences for those now placed further apart. However, as mentioned above, tightly intercoupled collaboration relies on others being able to make sense of the activities of those nearby and being able to design their own conduct in the light of this with regard to the likely consequences of an intervention. This requires an understanding of the tasks and responsibilities of colleagues. In the centers of coordination that were the focus of earlier workplace studies, staff drew on many years of experience of working side by side with others to inform how they collaborated with others who had different responsibilities.

There are kinds of technologies that could be envisaged to better support collaborative activities in such a space. The very size of the space means that a single visual resource is unlikely to be accessible in the same way to all. Larger, more public displays can make accessible information of general concern to a team, but the information displayed needs to be carefully considered if it is to engender more focused forms of collaboration. Similarly, audio can also provide publicly available

resources for supporting collaboration. At present, simple audio alarms are made publicly available through loudspeakers. This indicates each time a call is received and, by their frequency, can provide a sense of the state of the service. It is possible to consider other ways in which the audio environment could be augmented to support ways of distributing information among staff, much in the same way loudspeakers in other control rooms also broadcast the details of calls. With consideration of more directional approaches for projecting sound, such technologies might provide more tailored ways of distributing information such as just for those within a team (cf. Aoki, 2009). However, any transformation to publicly accessible technologies cannot be taken in isolation, and would need to consider transformations in organizational practices, particularly how work is allocated; otherwise, solutions that aim to assist collaboration might be more disruptive and place even more demands on staff.

There may be simpler ways in which collaboration could be enhanced within such large control rooms, and these may rest on ways of augmenting the current text-based systems. These were designed before staff were collocated. Although there are additional legal requirements for recording information within the different organizations, particularly for the police, for those other staff in the control room, a more consistent and integrated system for recording incidents and responses could be envisaged. For example, by considering the requirements of different teams and suborganizations, the ways in which incidents are recorded could be enhanced, even if this was just by changing the ways different fields are presented so they reflected the concerns of members of other organizations, or automatically completing some details from the information available on systems that are not currently integrated. This may support the ways staff, particularly in different teams, can assemble sense from the records. It might also be feasible to enhance the systems so they reflect how they are used in a copresent setting, for example, by identifying staff not just by their (code)-name but their location within the room. In this way, the technology may start to be shaped with respect to the way it is used, within a copresent, physical setting, but also with regard to the different uses that are made of information within a team and between staff in different organizations.

In this paper, we have considered how a fairly conventional information system is used to anchor and support collaboration in an environment where staff are collocated and how the textual recording of incidents facilitates the coordination of activities. In earlier studies of control rooms, logs were largely kept for bureaucratic purposes. They largely served as reports of activities and, if necessary, provided a resource for the evaluation and assessment of particular activities. The records were produced as reports, warrantable accounts, of activities undertaken by staff. They reflect and embody the routine progression of particular problems and the ways in which the proper management by competent professionals attends to, and reproduces, the proper management and resolution of particular troubles. The design of the texts, and therefore, the ways in which items are described and assembled, provides instructions as to its span of potential relevancies and what information is potentially relevant on subsequent occasions (cf. Garfinkel, 1967; Heath & Luff,

1996b). In contrast, in the case at hand, the records are ongoingly produced and designed to enable and provide a resource for the concurrent management of emerging activities. They are written in ways that enable and facilitate coordination and collaboration. They are written economically, to be read by a colleague who may be attending to, and have to contribute to the management of, an emerging incident. In turn, these colleagues may well contribute to and transform the record, and provide resources to enable others to intervene and advance the management of a particular event or incident. The records are malleable, shaped to be consistent, and relevant to the current circumstances of both readers and writers. The reports both enable and engender action by relevant people, but not necessarily particular individuals – and facilitate different people, sometimes with different responsibilities, to make sensible and relevant contributions without having to depend on a potentially variable or unreliable voiced description. There seem to be two critical reasons why these reports take on a different status within the large control room and why they are of a different character. In the larger control room, there is a division of labor where a number of operators concurrently deal with emerging incidents as they happen. There are also potential (and necessary) contributions of others both within and outside the control center, for example, the police. Thus, an 'accurate' emerging record is critical; it is an anchor, to enable multiparty and in some cases multi-occupational interventions.

## 7.2. Analyzing Colocated Activities Mediated through Technology

Through undertaking the original studies of centers of coordination, researchers developed a range of methods and approaches for gathering data and subjecting these to analysis. They drew on fieldwork in the setting to reveal the organizational context that forms a foundation to work, they undertook detailed observations of the use of artifacts both physical and electronic, and through video recordings, they could subject moments of coordinated activity to detailed and repeated scrutiny. Very large control rooms raise additional challenges for the analysis of workplace activities.

Staff make use of technologies that are typically characterized as 'asynchronous' to support their work, relying on resources that persist through time, typically through textual records. Therefore, analyzing these activities requires not just the analysis of fragments of interaction, of talk, visual conduct, and material actions around a common resource, but also how texts are produced and made sense of within this course of activities. In part, this requires the development of analyses that integrate approaches undertaken in different kinds of centers of coordination, for example, studies of interaction between participants who are copresent (Goodwin & Goodwin, 1996; Heath & Luff, 1992) with those previously undertaken with remote participants (e.g. in call centers; Whalen, 1995b; Whalen & Vinkhuyzen, 2000; Whalen, Whalen, & Henderson, 2002). These domains require researchers to integrate analysis of screen work with copresent activities and take account of a range of responsibilities and concerns of a wide range of participants. For example, to make

sense of even the simplest call and how it is handled requires access to a wide range of materials, but also over an extended period of time. It requires analysis that integrates access to the activities undertaken on the screen – how these are read, interpreted, and how texts are written and fields entered – with audio recordings of radio and phone conversations from staff both within and outside the operations center.

When considering complex forms of collaboration, analyses need to draw on these resources to consider how copresent colleagues collaborated from moment to moment. However, as mentioned above, this was infrequent while they were located close to a common resource. In many ways, the problems of data collection reflect the problems of collaboration found in the setting – it being hard to anticipate moments of collaboration and to identify and capture data of those in the local environment who could be engaged with the current task at hand.

Data collection then involves more than one fieldworker, numerous recording devices, and different kinds of fieldwork. In this case, it involved two fieldworkers principally focusing on two different reams of different locales, each being recorded from two perspectives – a focused view of the screens and a wider angle of the local workspace. This was the minimum necessary and required dealing with the complexity of managing problems that draw on multiple cameras and resolving the different perspectives revealed by each (Luff & Heath, 2012). These data were augmented with fieldwork about the ongoing incidents and how they were being managed, and audio recordings of the phone calls to the members of staff being focused upon. Even when undertaking this approach with no clear division of labor or prescribed allocation of tasks, it was only by happenstance if relevant parts of a chain of communication within the control room were recorded. It required many hours of recording and extensive reviewing of the recordings to subsequently identify moments of collaboration. This was particularly problematic when collaboration was through electronic texts and when contributions were made that were many minutes or even hours apart.

Besides problems collecting data, these large copresent settings present challenges for the analysis of data collected. With such a range of heterogeneous materials, it is hard to warrant particular analyses. In previous studies, the warrant for a particular analysis could be made by considering the sequential production of activities, namely the immediately prior action and the next. Thus, an orientation toward a screen by a member of staff would be considered with regard to some event that occurred immediately prior to the reorientation. The analysis could be warranted by drawing on the subsequent actions by colleagues in the setting, if they undertook an action that was engendered by the other participant, for example. When staff are more widely distributed and activities extended over time, such sequential analyses are harder to develop. Sequential relevancies need to be established among texts, talk, and visual conduct. Analyses also need to be warranted with respect to activities that may have occurred some time apart, so that, for example, a 'response' made by a member of staff through one media is tied to an 'action' taken by others through another. In these larger and more dispersed settings, it is a challenge to identify

patterns of communication, whether staff are working in collaboration or separately, let alone reveal interdependencies between activities and warrant that those interconnections are relevant for the production of coordinated activities. These multicenter control rooms and workplace studies of other large collocated studies require access to different kinds of data, analysis that integrates different kinds of data, and fieldwork and ways of warranting analyses of such heterogeneous materials.

## 7.3. Multicenters of Coordination

These analytic problems seem to reflect the problems participants face everyday in this setting, and no doubt many other large modern distributed organizations. From moment to moment, they have to manage a range of resources that might be accessible through a range of media, some transitory and others more persistent. These may arise from the activities of participants who may be close colleagues or any member of a very large network of organizations and suborganizations. Staff produce conduct in this large space that make others, either particular recipients or more general audiences, aware of their own actions, even when these are not clearly visible. They transform different kinds of 'information' through different media to serve the demands of different individuals, with differing responsibilities in those various organizations. They assemble coherence from a range of fragmented real-time resources that facilitate collaboration with collocated individuals and with those who are geographically dispersed throughout a large area, activities that have consequences for thousands or tens of thousands of other individuals.

These very large centers have many of the features identified by Suchman as 'centers of coordination' (Suchman, 1997). They are locations where participants work together in the same space where those participants have an 'ongoing orientation to problems of space and time' regarding the 'deployment of people and equipment across distances' and the 'emergent requirements of time-critical situations.' However, these large centers of coordination are themselves domains where there seem to be distinct concerns. The problems participants manage are more diverse, and it is hard to sustain that they share a world in common. The problems they face and the solutions they deploy involve multiple trajectories of courses of action through time. At any moment, staff are managing multiple activities, collaborating with different configurations of colleagues with different demands and concerns. In many ways, it is unclear whether their co-presence in the same physical space is the critical aspect that shapes how they collaborate. For colleagues sitting side by side or members of a team, it can be highly consequential. Being in the same place makes possible subtle forms of communication and collaboration. Practices that have been characterized as 'peripheral participation' and 'mutual monitoring' rely on the conduct of staff being visible and audible, or partly visible or partly audible, to a number of colleagues. Hence, an action can be seen to be relevant by another and also demand a response or contribution from a colleague. And yet alongside these practices, staff utilize other ways of communicating and collaborating with others in

the same space in ways they would if their colleagues were not copresent. Being in the same physical space shapes forms of collaboration; by making possible visual and audible access to colleagues, it makes possible subtle and rich forms of participation. However, the ecology also constrains the ways such practices are deployed.

The original studies of centers of coordination had a considerable impact on CSCW: they not only identified practices that are critical for the understanding of collaborative work, but also served as exemplars of the approaches and methods researchers would need to undertake within the emerging field (Dourish, 2001, p.73). Indeed, the use of ethnographic approaches, particularly those drawing from an ethnomethodological orientation within CSCW, and then more broadly within HCI, can be traced back to these studies. They served to 'sensitize designers to the sociality of work' (Crabtree, 2003, p. 88) and also suggested methods for contributing to the design and development of innovative systems (Crabtree et al., 2012; Heath & Luff, 2000; Luff, Hindmarsh, & Heath, 2000; Randall et al., 2007).

Practices that seemed to make the original centers of coordination distinct were embedded within the tasks and responsibilities of the participants. Staff were not only aware of what colleagues were doing but also aware of the consequences of particular actions for themselves and others. They anticipate the likely next actions of a colleague and hence could ensure any interventions were timely and sensitive to the ongoing conduct of a colleague. This multicenter control room may appear to be quite a distinctive work setting, and yet the nature of the activities, the technologies used to support the work, and the problems faced by the participants in this setting may not be that dissimilar to many contemporary workplaces. As in many open offices, staff sit at a number of desks in a large space, taking calls and responding to electronic communications while using a number of computer applications available on several screens (Licoppe & Tuncer, 2014; Salvadori, 2016). They often need to interrupt others in order to engage in *ad hoc* discussions with colleagues, record the results of those discussions in a written report, identify from a range of sources in different media matters that may be important to others, and make those others aware of these. Such problems need to be managed with regard to not only organizational requirements, but also the socio-interactional demands of colleagues and co-participants. Participants need to transform information, data, and other materials from one media to another, frequently from computer systems into talk and vice versa. It may be that by integrating control rooms together into larger spaces, providing individuals with personal technologies, and paying less attention to public resources, activities in control rooms and other centers of coordination seem less distinctive. The qualities of these activities have more in common with other contemporary work settings. Rather than appearing to be settings where a quite distinctive kind of work is accomplished, developing an understanding of practices in contemporary control rooms may also reveal issues of relevance in more generic kinds of workplaces.

Perhaps surprisingly, studies of the use of technologies in offices, large or small, or indeed the ways in which technologies are made at home in the workplace, are rarely a matter of concern by researchers in HCI and CSCW. Despite its longstanding concerns with the details of people's interaction with computers, there are still relatively few studies

that examine how everyday computer systems, applications, and tools are used in such commonplace settings as the office. Indeed, while there are numerous studies of collaboration within different kinds of workplaces in CSCW, few of these consider the details of the moment-to-moment activities undertaken by participants on and through computer systems. Such studies seem to fall between the concerns of the fields of HCI and CSCW. Where studies of human–computer interaction focus on the detailed use of technologies, they tend to focus on individual capabilities and activities. When studies of collaborative work consider artifacts, they tend not to focus on the detailed, moment-to-moment accomplishment of technologically mediated activities. Studies of everyday copresent work require both attention to the details of how technologies are used and how the activities of individuals are shaped and shape the conduct of others, whether they are in the same space or elsewhere. Copresent work is now thoroughly interwoven with the management of dispersed individuals and distributed information. Understanding the details of everyday work, how participants manage the demands of both copresent and distributed work seems to be critical to understanding the contemporary use of computers and communication systems. Developing methods, approaches, and concepts to explore the everyday, moment-to-moment use of technologies in workspaces, both large and small, may also address the recent neglect of what is a pervasive workspace in the modern world – the office.

## ACKNOWLEDGMENTS

We would like to thank the staff and management of the STTOC for their help and generosity supporting this study. We also greatly appreciate the valuable and insightful comments of the reviewers and editors of earlier drafts of this paper.

## NOTES

***Acknowledgments.*** We would like to thank the staff within the LSTTOC, particularly those in CentreComm, for their help and participation in this research. We are also grateful to members of the Work, Interaction and Technology Research Centre, particularly Jon Hindmarsh for insightful comments and help when discussing the data.

***HCI Editorial Record*** First received on <date>. Revisions received on <date>, <date>, and <date>. Accepted by <action-editor-name>. Final manuscript received on <date>. – *Editor*

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