

Chapter 16

Control Rooms

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Summary

Lancaster was one of the pioneering centres for conducting social analysis of different work settings. From the end of the 1980s and onwards the rise of social analysis went alongside the development of networked systems to support cooperative work. Social analysis, particularly ethnographic (observational) fieldwork, is considered a particularly well suited approach to studying cooperative and social aspects of work, to be supported by technology. Furthermore, there was a growing interest in multi-media sites and applications. Due to their variety of technologies and for their concentration of staff within a circumscribed area, control rooms were very popular for conducting studies – indeed, they were known as the multi-media field sites par excellence. Attention was also drawn to these sites for their safety and time critical nature – mistakes could have a high impact so dependable technologies and dependable working practices were crucial.

Background

Control room studies were hallmark studies in the discipline of Computer Supported Cooperative Work (CSCW), a discipline that grew out of the 1980's as networked computers and shared applications offered new possibilities for people to work together, at a distance. One relatively novel aspect of CSCW was that with its focus on cooperative and social use of computers, sociologists began to work within the discipline, pointing out that that if you want to design systems

to support social and cooperative aspects of work, you might want to first have a good understanding of how the mechanics of these play out in current work settings, potentially the ones that you were looking to augment with new technologies, distribute and so on. In a confluence of good fortune and planning in the late 1980s a number of field study opportunities arose within projects focusing on control rooms.

At Lancaster University Dave Randall and Richard Harper conducted field studies of air traffic control room, working alongside other sociologists and computer scientists, led by John Hughes and Ian Sommerville, working in a truly mixed team. They produced a series of articles into the 1990s. At Kings College London a similar study was being conducted of London Underground control by Christian Heath and Paul Luff. Over the following years more studies were carried out in air traffic control by Lucy Suchman, Wendy Mackay and Maria Normark while studies also focused on other control rooms, notably a series of studies on ambulance control conducted in Manchester, UK (Martin) and Sweden, (Pettersen, Normark). The series of control room studies have proved very fruitful being as they are particularly suitable for conducting ethnographic studies as most things are happening in the one place and they are rich in social interaction and in technology – but even more so they have provided some of the key empirical findings within the discipline of CSCW. And these findings have had a strong influence on elements of technical development over the years.

Air Traffic Control and London Underground Control

The control room studies focused on the details of cooperation and coordination of workers in situations that were often time critical. A second key feature of the studies was the examination of the roles of different technologies, some basic some more high-tech. Of particular interest was the ways in which workers interacted with technologies or worked with artefacts in a manner that cooperative work was achieved through the artefact with minimal need for control room workers to engage in overt conversations about the activity. Years of working together had allowed the workers to rather seamlessly coordinate their actions through observing the placement of artefacts and people's interaction with them.

To provide two concrete examples: firstly, in air traffic control the researchers drew attention to the use of flight strips. These paper strips contained all the key information regarding a plan and flight – flight number, carrier, times, flight path etc. As information about the flight changed – i.e. how it was being directed by the controllers, timings etc. – so the strip was amended, and in this

way with its alterations the workers could see how the flight had changed and who had made the decisions. Another feature of the flight strips were that they were displayed on a wall, meaning workers could see the list of flights to deal with at-a-glance, and problem strips were even 'cocked-out' (made visible) so workers in general could orient to the issue. These features of the strips allowed people to see the work undertaken by others, their decisions and to orient to issues as a group.

The second example comes from London Underground Control. In this situation you have a controller (in charge of the management of the train schedule) and an announcer (who lets passengers waiting at stations know when to expect the next train) working together in the control room. The main technologies used in this setting for the controller were audio and video links, the 'fixed line diagram' (a strip of lights that showed the real-time progress of trains towards the station) and a paper timetable of planned train times.

A significant feature of the work is that the timetable serves like a basic plan but that due to all the contingencies of the Underground system the workers need to modify and update the schedule on-the-fly due to small delays, problems, incidents and so forth. This often means updates whereby trains swap places, are late etc. This study focused on the way in which the controller and announcer could coordinate their work in a fine-grained manner, such that the announcer could enchain his tasks of letting the public know almost directly on the actions of the controller. This was achieved through both having a shared view on the fixed-line diagram but also through their proximity, the announcer could listen in to the conversations of the controller with drivers and prepare and make his announcements accordingly. The controller could also make elements of his work more visible, by formulating his words in conversations to be overheard, by looking pointedly at the fixed-line diagram and even stressing or emphasising actions. In these ways close coordination was achieved.

Key Findings and Ideas Arising

In these control room studies, therefore, some key concepts were beginning to be developed. These focused on the means by which workers monitored visually or listened into one another's work as a means of understanding what was going on and planning further actions but also reciprocally how workers made available to others features of their on-going work such that others could pick up on actions and act themselves. Other key feature of this work was the role of technology in supporting these shared understandings – sometimes, just from watching interaction, sometimes the modification or display of even

rudimentary technologies like flight strips. These phenomena became subsumed under the concept of 'awareness' within CSCW. People became very concerned that this was a key concept to support when working at a distance on shared systems, whether synchronously or asynchronously. People cannot pick up on what is going on simply through being collocated in the same environment – one needs the system to communicate elements to do with people's activity, what work they have carried out (if on a shared document etc.), maintaining details of what changes have been made by whom, status, even features of their local environment in order for them to work together more fruitfully.

A second key concept that arose from these studies was the coordination or articulation work that actors engaged in, in order to mesh together their tasks. Researchers pointed out that this work to coordinate separate activities was something not often paid attention to in the design of systems. For example, air traffic controllers needed to ensure that they managed the boundaries between different flight sectors as planes travelled between them. And we also have already discussed the importance of the tight integration work between the two separate activities undertaken between the controller and announcer in the London Underground control room. Building on this Martin and colleagues noted how different ambulance dispatchers also worked around the boundaries of their sectors to ensure that ambulance dispatch decisions were appropriate for ensuring rapid response to incidents while maintaining good coverage for the whole of the region. Indeed in times where the service was stretched dispatchers needed to work more as a team, and often their supervisors were also engaged, the group as a whole working together to share information and local knowledge on features such as the drivers levels of stress, road conditions and so on meaning that a good overall service could be maintained.

Coming out of the research on articulation work and awareness was also the finding that having shared artefacts or technologies that allowed actors to see an overall picture of a service status or multiple different views of a service was important to understand what was going on in the service as a whole and what other people they needed to coordinate with were doing. In air traffic control there were the flight strips as well as representations of the air space in sectors. In London Underground control there was the fixed-line diagram. When this was augmented with aural access to on-going conversations the announcer was able to understand what was happening and construct his announcements accordingly. In ambulance control dispatchers could view shared lists of ambulances on call or ready to dispatch for the whole region, as well as a quasi topographic representation of the region showing the status of all ambulances. Working with these together with their own local representations and lists for their area they were able to manage individual and group work. For example, a dispatcher who

was not currently very busy could look at her neighbour's workload and offer assistance in the task. This work certainly influenced work concerning the design of what are now better known as shared information spaces – technologies for groups to orient to and organise their work.

Comparative Opportunities

As should be clear from the above sections building up a corpus of control room studies was not only useful for the results in themselves and the concepts that became more settled design concerns in CSCW – they actually offered great opportunities to synthesise results. Specifically within the domain of air traffic control there was some work looking at how different control rooms functioned, whereby they could be compared and contrasted in terms of their practices and deployment of technology. Furthermore, some articles by Dave Randall and colleagues focused on Swedish ambulance control but offered up a means by which various ambulance studies could be synthesised in terms of the dimensions of 'ambiguities', 'awareness' and 'economy'.

These were shown to be relevant features of all the studies discussed but played out in different ways responding to sometimes slightly different problems. Field studies have been questioned for their generalising possibilities but across the control room studies a reasonable corpus of knowledge has been built up that means that we often see similar types of work organisation and technological solutions. This background can be thought of generative in an analytic fashion – it aids in the analysis of new settings in a comparative fashion rather than predicting what will be found or prescribing ready-made technological solutions, but nonetheless useful in looking at new settings.

Faltering From Ethnography to Design

We have already pointed to some of the more generic design concepts that have emerged from the control room studies. What was also important about these is that they were some of the first field studies to attempt to use the findings specifically to inform design. Here it is appropriate to single out the work at Lancaster that was published as 'Faltering from Ethnography to Design'. This catalogued a specific attempt by computer scientists to work with and from the ethnographic record to produce new prototype solutions for air traffic control what would be digital technologies that would maintain the functionalities that would support many of the important features of the work. This did not result in the design and deployment of a new air traffic control system but was crucial in

demonstrating the possibilities of sociologists and computer scientists working together in a fruitful manner, as well as the possibilities for using field study findings for design.

Retrospective: Moving Out of the Control Room?

As they moved onto new projects the Lancaster group produced a paper titled 'Moving out of the Control Room' in which they outlined four different ways in which field studies could be deployed in settings that were not control rooms, for example to assess the suitability of a proposed technology or to look at features in a complex distributed setting. In many ways this was less a plea that this was what people should be doing than a response that ethnography could handle settings that were not as conducive in terms of ecology and action. And in the following years field studies have been deployed successfully in many different settings. However, it seems fair to say that the control room studies were particularly successful – they had a great influence on the young field of CSCW, furnishing it with a number of key concepts and influencing some core technology ideas. And even now people are still going back into the control rooms for their studies today