CCTV Control Room Collaboration and Communication: Does it Work?

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Abstract
Despite the increased usage of surveillance systems and the technological advances, there is currently no conceptual basis and little evidence to assess how well CCTV actually works for the purposes for which it is deployed. It is important to identify whether CCTV systems and applications meet stakeholder goals, and support human operators effectively, in attaining the goals for which the system is set up. This exploratory paper highlights the early findings found in CCTV control rooms. A series of ethnographic observations along with semi-structured interviews were carried out at six CCTV public surveillance control rooms – six managers, six supervisors and 25 operators were interviewed. Findings reveal that current control room systems are not designed to support operator and system communication and collaboration when performing their tasks. Poor linked technology and a lack of task coordination was evident between operators and external agencies such as police operators and local businesses. Several Human Computer Interaction (HCI) issues were uncovered from the fieldwork. Findings will be used to form a set of best-practice CCTV control room design recommendations.

1 Background
1.1 Research Problem
A number of studies have investigated how dynamic systems and processes are managed by operators in control room environments such as air traffic control and nuclear power plant control centres. Despite this, there appears to be very little HCI research in security and surveillance control rooms. In the last decade, we have seen several changes take place in security - with a rise in crime rates, and the type and severity of crime events have also changed. Consequently the public’s perception and fear towards crime have also changed. More funding is available for CCTV and more advanced CCTV technology is also available. These changes have led the research discussed in this paper to form a number of important questions: How are CCTV control room managers managing new digital technologies? Do control room operators understand how to use digital technology and multiple systems/tools? The overall question this research attempts to tackle through exploratory cognitive ethnography is: Are public surveillance control rooms operating effectively and efficiently. This research focuses on the difficulties operator face with control and co-ordination of surveillance tasks. The relationship and performance of communication and collaboration between operators and external agencies, information management and task performance effectiveness and efficiency were explored using cognitive ethnography techniques (see Hollan, Hutchins and Kirsh., 1999).

1.2 Previous Control Room Research
Luff and Heath (1999) examined how control room operators used CCTV and other technologies within an underground transport control room environment. Luff found that the control room technology was difficult to manage because there were “so many separate interconnected
systems...and the use of these systems are thoroughly embedded within the many disparate activities of the personnel.” From this study, various user-system interactions were considered, however very little focus was placed on the HCI barriers to task operations. Gill (2005) attempted to assess the impact of public CCTV surveillance as a whole on crime and touched on the technology issues in control rooms. Gill reported that many control rooms had street cameras positioned in poor locations, video recording rates were too low and communication flow between operators and other CCTV stakeholders was very low. The research focussed on whether CCTV as a whole effectively reduced crime and not the effectiveness of control room operator interactions where technology is heavily used.

Currently, we know very little about how end-users utilise modern CCTV technologies to perform their tasks within busy CCTV control rooms. The focus of the research presented in this paper looks at the effectiveness of CCTV technology within several city centre control rooms. Ethnography was selected as a research method for assessing the effectiveness and efficiency of control room task operations for two main reasons: (1) Many Computer Supported Cooperative Work (CSCW) systems often fail because the design process excludes the social work context, HCI and human factors issues; (2) “Many of the existing methods fail to sufficiently recognise the social setting of the social nature of work,” (Hughes et al., 1993) – i.e. task analysis and interviewing. The nature of the observations adopted was something Hughes termed as “quick and dirty ethnography.” This method was considered appropriate as the current research contributions of this research (the best-practice design recommendations) aims to inform control room managers broader issues related to the acceptability and usability of CCTV control room design. The HCI aspect of this work was studied from a theoretical perspective of distribution cognition (see Hollan et al., 1999). This perspective works on the basis which “seeks to understand the organisation of cognitive systems.” Cognitive systems can be distributed across members of a social group (CCTV stakeholders: i.e. operators, police, management, public etc.) and involve the co-ordination between internal and external (material or environmental) structures.

2 Communication and Collaborative Tasks: Field Observations at Six Control Rooms

The aim of the fieldwork was to obtain a better understanding of the human-to-human and human-to-system communication, coordination, and control mechanisms in CCTV control rooms when information flow is high. The control rooms visited were set up to support several stakeholders such as the local police staff and the community i.e. clubs, pubs, shops and the general public. The coordination of reactive and proactive surveillance tasks such as patrolling CCTV screens, responding to police radio calls, and sharing imagery with police when needed were achieved in all of the control rooms visited using the same type of equipment. Equipment included: CCTV wall monitors; camera controllers; a Personal computer (PC); ‘spot’ monitors (these are 2-5 video monitors located directly in front of operators which can be used to grab a CCTV video output selected from the wall monitors); radio; and telephones. Despite the similarities, it was found that the workstation layout, equipment set-up, communication flow between operators and external agencies and the design of the tasks differed between control rooms. A series of overt observations and semi-structured interviews with a total of 25 CCTV operators, six managers and six security supervisors were made by one field observer. Five of the control rooms were based in London and one outside London. Observations took place per control room on average over a period of five hours. Visits were made to control rooms during morning, afternoon, and evening shifts. This was so that the operator’s tasks and activities could
be analysed under different situations. For example, different cameras were used under different lighting conditions and different criminal and suspicious activities were observed at different times. An observation checklist of ideas and areas of interest to the observer was followed (tasks, equipment, communication, workspaces etc.) which was used as structured protocol for the observation exercise. Operators and supervisors throughout the observation period were informally asked questions about ‘what was going and why they did tasks in that way.’ Responses were recorded and supported the observation notes.

2.1 Technology and Setup: Mapping Geographical Information
A recurring problem found in a majority of the control rooms was the way in which operators’ located CCTV screen(s) when attempting to follow a vehicle or person. Operators used paper-based geographical street maps with lists indicating the street names and camera numbers. Many of the operators said for this type of task, “having good local area knowledge was important.” Despite this, a minority of the operators lived in the areas they observed on-screen. Operators regularly shouted to colleagues across the room if they were stuck and could not recall the camera number or its location. Operators shouted louder and in a panic-like tone particularly when communicating with police operators via telephone or radio to follow targets of interest on-screen. The use of physical paper maps is a risky, ineffective, and inefficient method for searching and tracking targets. Paper maps can go astray and losing a map would lead to guess work, which added unnecessary time to the task. Several managers reported that considerable funding was granted by senior councillors and the Home Office for adding additional CCTV cameras to their systems. Many of the operators complained that there were “too many cameras to cope with” and found these additional cameras were often not updated onto the paper maps and camera lists.

A method to improve the efficiency and effectiveness of searching and selecting cameras would be to link the camera monitor views with a graphical user interface (GUI) linked to a geographical map of the surveillance areas linked to a comprehensive database of camera names and street locations. Such a method would avoid operators mishearing numbers and locations when shouting information across the control room; it would also avoid the risk of confusion. A simple coordinated tool can be used to allow operators to communicate with a common understanding of the situation.

2.2 Reactive Surveillance: Information Overload and Inconsistent Radio Language
Often, control rooms are thought of as small, dark underground rooms filled with surveillance cameras wall to wall, with a handful of operators idly waiting for something to happen on video monitors. This is untrue. In fact, tasks are not so much video driven and are more audio driven. Operators perform two key surveillance tasks - proactive surveillance (watching and waiting for something to happen) and reactive surveillance (responding to alerts from outside control room to react to a crime or suspicious event). From the two, the most frequent surveillance task operators perform was the reactive surveillance task. The most heavily used communication tool used for this task was the police and business radio. Close observations of operator actions and operator remarks showed that there were clear signs of cognitive overload with radios and telephones. Several operators commented that “the control room radio has too many different channels assigned and sometimes it can be too confusing what’s going on, especially when the phone is going off as well.” Operators also complained that business radio users such as city centre shop managers gave too much unnecessary information and that they did not give clear
descriptions of targets. Excessive radio groups and poor information flow between users are two of the most common causes of cognitive overload: (1) too much information supply and (2) too much information demand (Kirsh, 2001). A simple solution to minimise audio information overload would be to distribute radio channels across the numbers operators and the level of activity over the day proportionally. Distinguishable audio tones is useful method for funnelling initial incoming contact that is made with the control room, so that operators can prioritise and respond to radio calls accordingly. Feedback and training should also be provided to all radio users, so that consistent language is used such as phonetics and identity codes which are commonly used by UK police forces.

3 Conclusions
The field work described here highlights how computerised technology in city centre CCTV public surveillance control rooms are set-up and designed without considering what tasks are performed by operators. “Any design of computer systems for control room, which does not support intrateam communication and coordination, is very likely to fail in the long run,” (Garbis, 2000). Ineffective workplace designs currently in modern control rooms where information communication technology (ICT) is heavily used, can affect both internal and external communication – affecting the control and coordination of tasks. A combination of system re-design where existing systems can be linked together and training across stakeholders concerning the system can improve task effectiveness, efficiency, and overall work performance. Further control room visits are in progress. Findings will be used to form a set of best-practice recommendations for CCTV control room management.

4 References


