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CPNI
Centre for the Protection
of National Infrastructure

Human factors in CCTV control rooms:
A best practice guide

Introduction

Organisations which operate CCTV control rooms often focus on the technical or equipment requirements of the room. However, the 'human factor' within the CCTV system is equally as important in achieving the objectives of the CCTV function.

This guide aims to provide guidance about the 'human factors' that may affect the performance, health and wellbeing of CCTV control room workers and to inform the reader of techniques which may help to investigate or resolve particular issues.

The guide focuses on the design and running of CCTV control rooms with respect to the characteristics of the people that work in them. The stance adopted throughout the guide is that of user-centred design. Essentially this means creating a CCTV control room that is designed to support the activities of the control room staff and thereby ensure an effective CCTV function.

Who should read this document?
This guide is targeted at:

• first-line or senior managers who have responsibility for the CCTV operational function and wish to optimise CCTV operator performance;

• those who are tasked with the setting up or redesign of a CCTV control room.
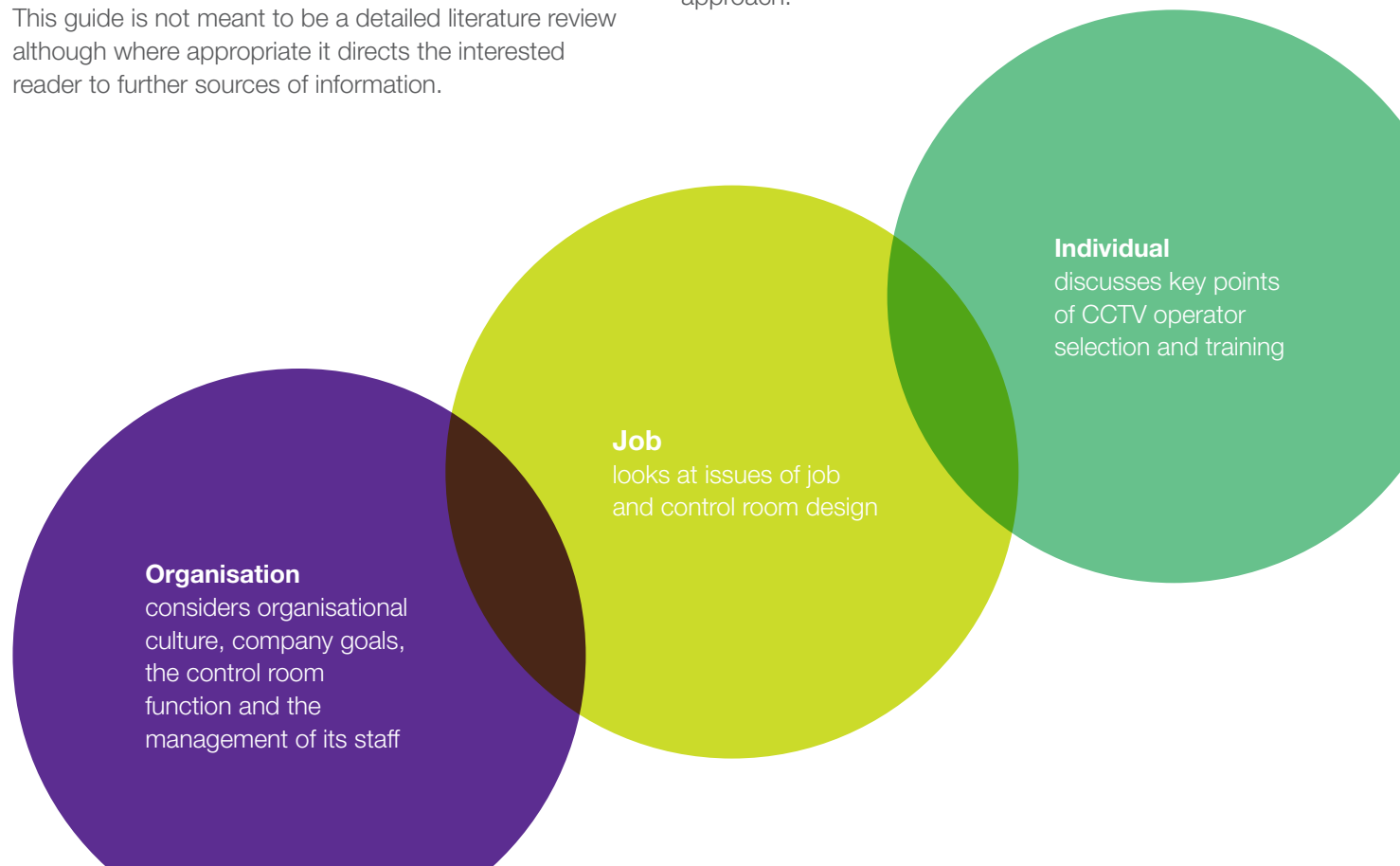
It is written for readers from a broad range of professional backgrounds, rather than human factors professionals.

As such human factors jargon is avoided where possible and the content is intended to provide a breadth of information about setting up and running a CCTV control room, rather than depth in any particular area.

This guide is not meant to be a detailed literature review although where appropriate it directs the interested reader to further sources of information.

How should this document be read?
It is recommended that this guide is read from cover to cover. However, it is structured so that the reader can find sections of particular relevance to current concerns. The discussion of human factors issues in control rooms is captured under three broad chapter themes – as illustrated below – reflecting a current 'best practice' approach.

Individual
discusses key points of CCTV operator selection and training

Job
looks at issues of job and control room design

Organisation
considers organisational culture, company goals, the control room function and the management of its staff

Introduction

It is acknowledged that, in practice, opportunities for CCTV managers to exert influence across all four areas (organisation, job design, operator selection and training) may be variable and that changes in the control room will need to be prioritised. However, from a human factors approach, each area contributes to operator performance and it would be unwise to address particular issues whilst neglecting others.

Each chapter in this guide is organised as follows:

- About the chapter
- More detailed information and explanation of the issues
- Key recommendations are highlighted throughout
- Supplementary information is shown in separate 'boxes'
- Further reading/sources of information at the end of the chapter

Finally the   chapter at the end of this guide provides more details on specific human factors issues, a summary list of recommendations as well as a list of relevant academic references.

What is 'human factors'?

Human factors is a multidisciplinary field which uses research from psychology, engineering, physiology and other spheres to understand how a person interacts with his/her world. Human factors is concerned with *fit*; matching the needs and limitations of the person to the design of equipment, jobs and work environments within the context of the broader environmental and social context.

Certain human characteristics – for example vision, memory capacity and attention-span – are considered to be similar across all individuals. Therefore, technical systems and job tasks should be designed to work in harmony with these characteristics. In other words, work should be designed to "*fit the job to the person*" in order to avoid human errors.

CCTV operator
CCTV team
Organisation
National culture
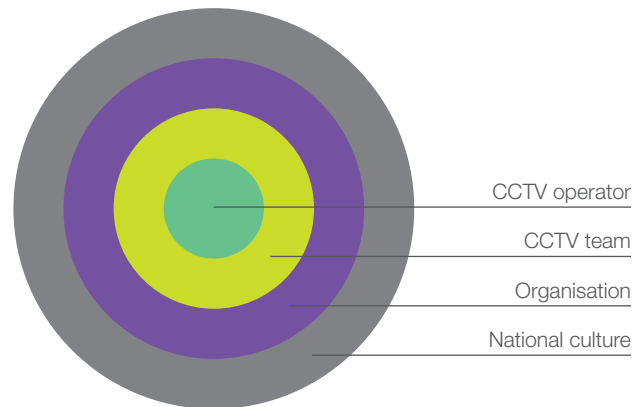
The immediate and broader social contexts in which the human operator undertakes his/her tasks from an human factors perspective

Other personal characteristics, such as job motivation and commitment, vary from person to person, but can be positively enhanced by effective training and leadership. In this case work-related systems should be designed to *"fit the person to the job"*.

Human factors embraces both these approaches with the aim of getting the best potential performance out of people. It considers the systems in which people typically work – see below left, using the example of a CCTV room.

- At the heart of the system the individual CCTV operator interacts directly with various technological devices (computer interfaces, camera controls, radio, etc). The amount and type of information that an operator can take in is limited and errors can occur.
- The operator also works with an immediate team which has its own practices and procedures, both formal and informal. Operator task performance can either be supported or inhibited by the way the team is organised and works together.
- The culture and management practices of the organisation also impact upon the individual and team in shaping behavioural 'norms' and job performance.
- While not specifically discussed in this guide, it is worth noting that national and/or ethnic culture may also affect the way people behave in various contexts.

Introduction

**Why is human factors important to
CCTV control rooms?**
A great variety of operations are conducted in different
types of control rooms. However, put simply, the job of a
CCTV operator can be summarised as shown below:

1
Taking in information about the environment
she/he is controlling or monitoring

**Situation
awareness**

3
Carrying out the most appropriate action
in response to the situation

2
Understanding how this information
relates to the situation as a whole
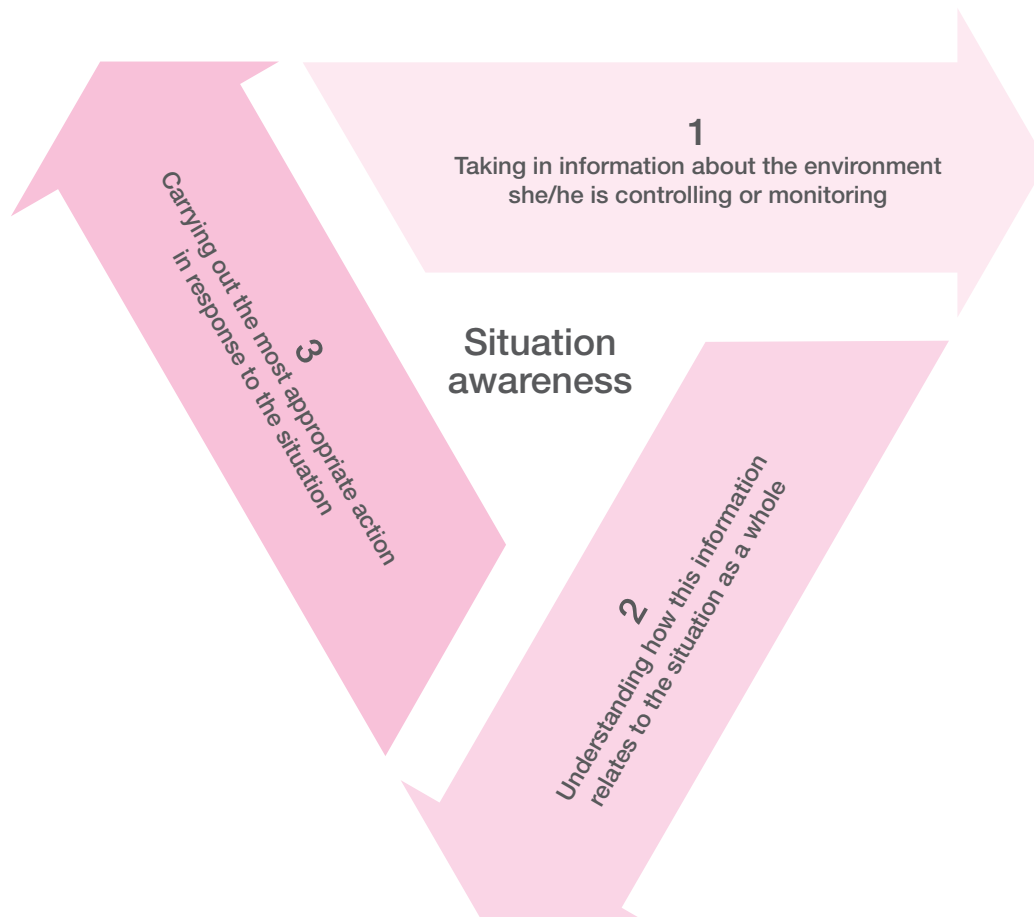
This process of understanding what is happening in a
dynamic situation is called '*situation awareness*'. This is
essentially: 'knowing what is going on so you can figure out
what to do'[1]. At any point in time each individual operator
will have his/her own level of situation awareness – ideally
this should be an accurate reflection of 'reality' and also be
shared by all other team members.

Whilst this may sound obvious, loss of situation awareness
can rapidly lead to inaccurate assumptions, decisions and
errors of action – with potentially negative consequences.
Situation awareness in a control room system can be
influenced by many factors. But in simple terms:

- CCTV operators must receive *accurate information* about
  the current state of any situation or incident – information
  comes from camera feeds, automatic detection systems,
  and communications with team members or other
  stakeholders.

- Operators should be able to see and understand
  the results of any action they have taken (i.e. receive
  appropriate, accurate feedback from control room
  systems or people) in order to make a decision about
  what to do next.

Whether at control room implementation or review, the
application of human factors knowledge can assist in
supporting operators' situation awareness and so optimise
performance and minimise mistakes, as well as protecting
worker health and wellbeing.

Organisation

About this chapter

This chapter deals with influences on CCTV control room operations and operator performance that originate from the wider organisation and its practices. Influences include the goals and culture of the organisation and the management and leadership of CCTV room staff. Only key relevant points are indicated here due to the breadth of the subject, but these are important issues which are often overlooked for control room operators.

The function of the control room – CCTV operational requirements

The function and tasks of the CCTV control room will be ultimately dictated by the operational goals of the organisation. For example, goals could be production/ process related, such as at a power station, or be about optimising customer experience and revenue, such as in a shopping centre. In turn, each setting will have its unique security and safety priorities. In order to meet these security needs effectively, it is vital that a formal CCTV operational requirements plan is prepared when planning the installation or redesign of a control room. The Centre for the Protection of National Infrastructure (CPNI) can provide advice in this area. An outline of the operational requirements process is shown in the box opposite. Human factors advocates a user-centred approach to design and therefore it is recommended that representatives from the CCTV operator team be involved in all stages of the operational requirements implementation process (the user-centred design process is covered in more detail in the technical sections of the chapter).

LEVEL 1 – Operational requirement
Define the problem
Statement of overall security need

- Prepare site plan.
- What are the threats to assets/people?
- What stakeholders do I need to consider?
- Is the aim to maintain safety of employees, deter intruders, or prosecute?

LEVEL 2 – Operational requirement
What do you want CCTV to achieve?
Define requirement for CCTV

- What/who do I need to see?
- Why do I need to see it?
- How am I going to see it?
- Technical specification – detailed CCTV system specification
- System commissioning and validation – how do I know it works?

Organisation

The key issue is to determine the nature of the security function that the CCTV control room is to fulfil, and then support CCTV operators in fulfilling this function by ensuring that security is appropriately prioritised in their day to day working routines. In practice it is rarely the case that CCTV control rooms fulfil only a security function – in addition they may act as an information point for customer queries, or a gatherer of evidence for the police, or provide administrative duties to the organisation in which they are based. A CCTV operator, undertaking a variety of tasks that fall under each of these functions, will inevitably have to prioritise particular tasks over others when the control room gets busy. This is discussed further in the   chapter.

Organisational culture and the control room
In the same way that individual organisations have unique operational goals, each has its own unique 'culture' – sometimes referred to as "the way we do things around here". A company's culture will have developed over a number of years and is expressed in its formal management practices and systems, communications, expressed values or mission statements as well as in more informal practices and ways of doing things. All these factors will influence how emloyees are expected to behave (and actually behave) and which behaviours and attitudes are encouraged and rewarded or discouraged and punished. There may be a strict and formal hierarchy within the company or, in contrast, attitudes to authority

Although organisational culture may be difficult to define, if you have worked for several different organisations you may have noticed how the experience of working in one situation compared to another. Behaviours acceptable in one company may have been completely unacceptable in another. As an example, think about how the experience of in working for a City bank might differ from working for a creative design consultancy. How might the following aspects differ?
• Communication styles
• Dress code
• Challenging others' ideas
• 'Rules' of behaviour in the office
• Attitudes to authority
• Tolerance of individuality

may be more relaxed. Certain groups or teams within the organisation may hold their own beliefs and have ways of doing things which differ in some ways from the wider organisation, and this might include the CCTV control room team. The overall culture of an organisation will also incorporate its 'security culture' – the CPNI provides further advice on its website on how to promote a healthy security culture (see **further resources** at the end of this chapter).

Recommendations
• The CCTV control room function and its operators should be visibly and actively supported by all members of the organisation, particularly by senior management.

Organisation

A full discussion of culture is not the aim of this guide and it is not expected that CCTV line managers can single-handedly change the wider culture within a company. However, it is important to consider how company culture could impact control room team attitudes and performance. Key aspects to consider here are given below – most of these relate to the 'status' of control room staff.

- In some settings, the status of security staff may differ markedly from that of other employees; in this situation it can be difficult for them to challenge senior colleagues (because of the 'power difference') unless their role is suitably supported. Sometimes, the CCTV room can be a base for members of other internal/external teams or agencies – in this case such power differences may operate within the control room itself. All team members should feel comfortable in communicating with and supporting others. Team cohesiveness can be improved by team training (see chapter) and effective leadership.

- In certain control rooms the staff may not have the organisation's formal (or informal) authority or power to escalate potential incidents directly to external teams or agencies (e.g. police etc). This may act as a barrier to the reporting of incidents or could cause unnecessary delay. Appropriate procedures and training (see chapter) and clarification of roles are important here.

- As well as helping or hindering the tasks they have to carry out, the status of the control room facility and attitudes towards its staff can affect operators' personal perceptions of job satisfaction and motivation to do a good job.

- The above issues may also be influenced by whether operators are contracted to an external company or employed directly by the organisation where they carry out their role; it is sometimes, but not always, the case that contracted employees may feel less committed to, or engaged with, the organisation compared to other employees. The treatment of contracted staff should aim to promote a sense of belonging and commitment to the site where they carry out their work.
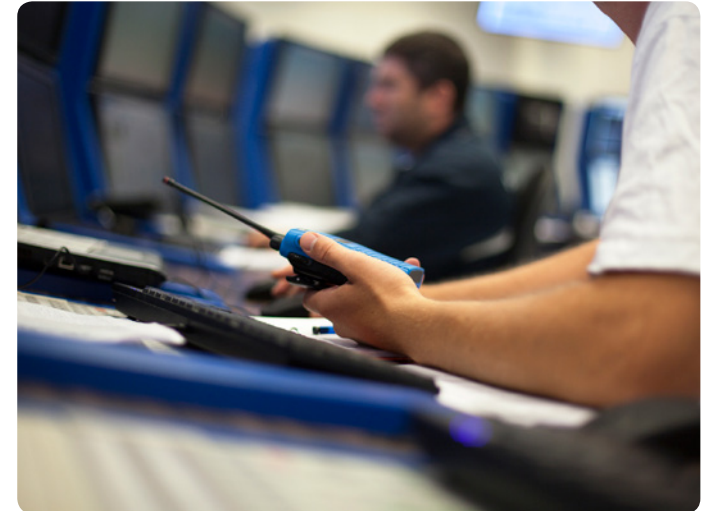
Organisation

Leadership and management of the CCTV team

Research indicates that highly motivated employees perform better and show more commitment to the organisation than unmotivated employees. The way that people are managed and led can significantly affect their perceptions about their job, and in turn their job motivation. Motivation can be a personal trait (i.e. be part of someone's personality) but it is strongly influenced by elements of the job itself (see also   chapter as part of job design). It is also associated with the rewards a person receives from doing the job. Rewards include the personal satisfaction from a job well-done, as well as recognition from the organisation's customers, team members and managers. Evidence suggests that poor management and leadership contribute towards employee dissatisfaction and job-related stress (see   chapter for more information on stress).

A way of looking at management is that it is about objectives and systems whereas leadership goes beyond this. Good leadership incorporates effective management but in addition affects team performance through influencing and motivating others to support job motivation, effectiveness and job satisfaction. Leadership and management are very broad subjects but basic issues are outlined below.

Leadership/management training

The minimum recommendation here is that first line supervisors and/or managers should receive formal leadership training which is aimed at achieving effective team and individual performance and which is appropriate for the context in which they work.

Appraisal

Regular appraisals help encourage employee motivation and maintain commitment. At minimum:

- Appraisers should receive appropriate training for conducting company appraisals.
- Appraisals should identify mutually acceptable performance and development goals. These individual goals are often linked to the goals of the team, department and/or organisation (see below).
- Appraisals may or may not be linked with rewards (including pay); however where they are linked with rewards care should be taken to ensure that the process of reward distribution is systematic and fair, and also perceived as such by all team members (see below).

Recommendations

- CCTV first-line leaders (supervisors/managers) should be appropriately trained in order to support and motivate their team.
- The CCTV operators' role should be supported by effective performance and appraisal systems.

Organisation

Goal setting

The setting of appropriate job-related goals is one way to support the performance of the CCTV team and its leaders. Often performance targets are managed by the human resources function; however CCTV managers should play a part in setting relevant goals for their team. Performance in an organisation can be managed on three levels[2] as shown below.

Ideally, the goals and targets of control room employees should reflect an integrated approach which aligns with organisational goals and the operational requirements of the CCTV control room and also form part of the overall appraisal system. The primary aim should be to develop key performance indicators (KPIs) for employees that in practice encourage the desired workplace behaviours.

However, care should be taken when considering group and individually-based goals for the CCTV team because:

- **Group-based goals** do not tend to have such a strong effect on performance compared to individually-based goals. The implication is that individual employees will have less control over goal attainment when performance targets are group-based.

- **Individually-based KPIs** have the potential to encourage individual performance to the detriment of team performance, especially if linked to remuneration. This means that 'extra-role' behaviours that are not part of a formal job description might be neglected in an effort to gain a high personal rating. This includes advantageous behaviours such as helping others to carry out their tasks or occasionally going beyond the minimum role requirements. Research indicates that these additional behaviours make an important contribution to organisational performance even though they are not formally required or rewarded[3].

Organisation goals
How well the company performs in meeting its vision, strategy and mission statement. These goals should be widely communicated and understood throughout the organisation.

Individual
Comparing how well the individual performs in comparison to others in the same role or how well the individual has developed in the duration of his/her employment.

Integrated
Integration of individual goals with organisational goals. This translates organisational goals into individual or group targets to encourage employees to promote organisational performance.

Organisation

More information on how goals work is given below.

How goals work

The setting of performance goals that are specific and challenging (but not impossible) and to which a person feels committed, is likely to improve his/her work performance as long as he/she receives feedback on progress. Research has confirmed the following:

- *Difficult/challenging goals lead to higher performance than easy goals as long as they have been accepted by the person trying to achieve them*. People direct their behaviour towards goal achievement, so that difficult goals produce more effective behaviour than easy ones.

- *Specific goals lead to higher performance than 'do your best' goals.* Specific goals create a precise intention, which in turn helps people shape their behaviour with precision.

- *Knowledge of results (feedback) is essential if the full performance benefits of setting difficult and specific goals are to be achieved.* Feedback provides a person with information and has motivating properties.

- *The beneficial effects of goal-setting depend partly on a person's goal commitment* – that is his/her determination to achieve the goal and unwillingness to abandon or reduce it.

Justice – fair treatment

Research suggests that employees actively monitor whether they are fairly treated compared to others within their own team and others in the organisation – for example in how rewards (such as recognition, development, benefits, pay etc) are distributed and shared. When people feel that they are unfairly treated, their commitment to the organisation is likely to decline and job performance can drop. It is important that supervisors and managers actively set out to treat each team member as an individual and demonstrate fairness of treatment in all aspects of interactions with and management of the CCTV team. The effects of experiencing unfair treatment can include withdrawal (disengagement from the job or organisation) and lack of motivation.

Managing expectations – communications

It is important that supervisors and managers set mutually understood expectations for the CCTV team. Evidence confirms that, as well as the formal employment contract with the organisation, employees develop personal beliefs and expectations about the role; these could be about rewards, expectations about development and about how he/she will be treated. These are not necessarily part of a formal written contract but are conveyed to the employee during interactions with the recruiters and interviewers at the recruitment stage and with leaders (team leaders, supervisors, managers) during formal or informal communications.

Employees' behaviour can be negatively affected when they perceive that their organisation has broken a promise made to them; this is whether the promise has been made explicitly or implicitly. Research in this area has suggested that breaches of this 'psychological contract' are caused by inadequate provision of human resource management practices, lack of organisational or supervisor support or when employees compare their deal, unfavourably, with other organisations.[3]

Consequences of this 'contract breach' are reduced employee well-being, negative job attitudes, job dissatisfaction, low commitment, lower job performance, reduced organisational citizenship, and increased withdrawal, such as leaving the organisation. In extreme cases, disgruntled employees may resort to retaliatory behaviours against the organisation (the so called 'insider threat')[4]. Effective leadership and communications can mitigate these types of behaviours but as an additional check it is recommended that all employees are interviewed when they leave the organisation.

Organisation

Further resources

Operational requirements
See CPNI website
www.cpni.gov.uk

Culture
Schein, E. H. (2010).
*Organizational Culture
and Leadership.*
San Francisco: John Wiley.
The CPNI provides advice on
security culture on its website.

Leadership
Antonakis, J., Cianciolo,
A. T & Sternberg, R. J. (2004).
The Nature of Leadership.
London: Sage.

Motivation
Latham, G. P. (2007).
*Work Motivation: history, theory,
research and practice.*
London: Sage.
The CPNI has published a detailed
advice document on guard force
motivation
See the CPNI website
www.cpni.gov.uk

Psychological contract
Rousseau, D. M. (1995).
*Psychological Contracts in
Organizations: understanding
written and unwritten agreements.*
London: Sage.

Job

About this chapter

This chapter deals in detail with what happens within the control room itself. It considers *job design* – the types of tasks done by individuals and allocation of activities to be carried out amongst the team. It also covers the immediate *physical* surroundings in which the operator works – both technological and environmental (sometimes called 'ergonomics'). Overall, this is about *'fitting the job to the person'* – the message throughout is that good job design supports good performance and minimises human error.

Task design for job satisfaction

As mentioned in the   chapter human factors recognises that the way employees are managed and treated by leaders will influence their motivation to do a good job. However, the features of the job itself can also affect job satisfaction. Job satisfaction in itself does not necessarily guarantee that a person will be highly motivated; however someone who experiences low job satisfaction is highly unlikely to be motivated. Evidence suggests there are particular elements of a job that can contribute to job satisfaction[5].

Skill variety – the opportunity for an employee to use a variety of skills.

Task identity – performing a task through from beginning to end and be able to see the outcome.

Task significance – the perception that a job has an impact on other people, either inside or outside the organisation.

Autonomy – allowing the job-holder to exercise choice and discretion in his or her work.

Feedback from job – how far the job, in itself, provides information to the job holder on how well he/she is performing.

There may be scope for managers to influence the design of the CCTV roles within their team, in which case the above can be used as a guiding framework to make these roles more motivating. Most efforts to redesign jobs achieve this by adding more tasks to a role or greater decision-making or challenge[6]. In addition, known techniques such as job rotation (where an operator will assume different team roles on a regular basis) and semi-autonomous work-groups (where a team of operators will be more self-directed than is typical) can be useful for redesigning jobs with the aim of increasing job satisfaction.

Recommendations

- Individual jobs should be designed to promote job satisfaction – this can be achieved by altering job characteristics rather than focusing on financial remuneration.

Job

Task workload

The amount of work that each individual team member will have to do at various times is a very important consideration for designing jobs. This is known as workload which can be understood as the amount of work (mental or physical) an individual has to do and the time available to do it in. Everyone has different talents which may affect how much capacity they have for satisfying task demands. However both long-term work overload (too much work) and underload (not enough work) pose a risk to well-being and effective functioning for the control room.

Overload is likely to make an individual feel stressed, and increase the chance of mistakes being made and work quality reducing. Stress can also put both physical and mental health at risk. Additional information on stress and how to measure the extent of stress in the workforce is featured in the   chapter.

Work underload tends to promote boredom, distraction and general dissatisfaction. Mistakes due to work underload are very common, especially in workplaces where there is the need to carry out routine, repetitive tasks. Underload can be addressed by considering job design (see Task Design above).

The amount and type of work that overloads and underloads an operator will vary, and it will also vary as the operator becomes more proficient in a job role. It is therefore advisable to measure workload where this is suspected to be an issue – see the chapter.

Task automation

Humans are good at carrying out relatively varied work, while machines can process vast quantities of information and be used to complete more boring or predictable tasks. For example, intelligent detection systems (e.g. fence or door alarms) are often used in CCTV rooms to replace continuous human monitoring and automatically detect intruders or other events; alarms (auditory or visual) are often linked to these systems.

Use of these systems should be very carefully considered in the context of other tasks that operators need to carry out, the main question being – is detection actually enhanced by such devices? Making certain processes automatic can help to reduce the burden on operators but it is important that operators can override such automation for more unusual operating conditions.

In addition, in practice it may not always be the case that the workload of operators is actually reduced, especially if systems are unreliable or generate an unacceptable level of false positive, or false negative, alarms. One of the key decisions for developing a new control room will be in deciding how much intervention is required by the operator for these kinds of tasks.

Recommendations

- The dynamic workload of individual operators should be assessed in order to avoid work overload and underload, as these can lead to stress and/or human error.

- Automated processes and alarms (that enhance/replace operators' tasks) can be time-saving but it is critical that operator control can be quickly resumed if required and that systems are reliable and not prone to false alarms.

Job

Vigilance tasks

Some control room tasks may need to be divided up on the basis of length of time for which an operator can continue to effectively carry out a particular task. This is especially critical for monitoring tasks that require intense and sustained attention, because as time goes on, this attention wanes and detection of a person, object or other change in the environment becomes less likely or slower. This is known as the vigilance decrement, which typically occurs after 20 to 30 minutes of continuous work (varying with the level of concentration required)[7]. This is more of a concern for those control rooms which rely on spotting events in the monitored environment to maintain an important security function. In this case there are important connotations for the length of time an operator should be expected to monitor screens for without rest breaks or task changes.

Shift patterns

The Working Time Directive (see Working Time Regulations, 1998) is the governing piece of legislation with regard to working hours and rest breaks for workers over 18 in the UK. However, the aim here is to explain what some of the effects of shift work may be and how negative consequences can be reduced.

Research confirms that the interruption of circadian rhythms (the 24 hour natural bodily cycle) by shift work can have a negative impact on both general wellbeing and physical health (short and long term), as well as on performance due to general fatigue (i.e. an increased likelihood of errors).

- 12 hour shifts, although common in many settings, may represent a greater risk to health and performance than 8 hour shifts in terms of higher perceptions of workload, fatigue and stress, risk of more errors and accidents, and higher health risks[8].

- There may be a benefit to limiting shifts to 8 hours where the nature of the work is particularly safety critical, although it should be emphasised that employees may prefer a 12 hour rather than an 8 hour system.

- Continuous night shifts are not generally recommended; in fact there is evidence that the working of night shifts may increase the risk of heart disease.

- A rapid rotational shift design rotates early, late and night shifts (i.e. 2-2-2 or 2-2-3) in a clockwise direction. This has been shown to reduce negative shift-work effects in combination with a minimum 24 hour break after a night shift.

- There are individual differences in how people tolerate shift-work and a few people will never be able to effectively adjust. This is especially evident in the extent to which work interferes with home and family life due to shift patterns. For those with childcare or other care duties, allowing flexibility of shift patterns to better accommodate childcare arrangements may help to improve the reduction in health and well-being that is typically reported by shift workers.

Recommendations

- Human attention span is limited and tasks that require intensive sustained vigilance such as monitoring CCTV feeds for critical security breaches should be covered in brief shifts of around 20 minutes.

- Shift-patterns are often designed to meet commercial and operational requirements but serious consideration should be given to minimising negative effects on health and well-being by the use of appropriate shift patterns.

- Where feasible operators should be able to exercise some control in choosing a shift pattern that suits their individual circumstances as this can help reduce negative effects.

Job

Job design and situation awareness

As mentioned in the   chapter, accurate operator situation awareness is vital to the effective operation of the control room. This section talks in more detail about job factors which influence both individual and team situation awareness and gives methods for helping to overcome them.

Individual limitations and situation awareness

Limitations in 'information-processing' – the way that information is taken in via our senses of vision, hearing and touch and then processed – are common to all individuals. The main limitations that can contribute to inaccurate situation awareness and errors within the control room are described in more detail in the   chapter at the end of this guide. These limitations cannot be eliminated, but some tips for how to mitigate their effects are described. It may be useful for operators to have a basic awareness of these (see   chapter – training section).

Shared team awareness

Control rooms should have appropriate formal operating procedures that align with the operational requirements (see   chapter) and are mutually understood by all team members. Beyond this, the way that team members work together, share information and communicate will all have an impact on situation awareness. As well as teams inside the control room, this includes those from other 'external' teams that may frequently work with the control room – for example guard-force teams or emergency services. Team situation awareness requires not only the necessary individual situation awareness necessary to carry out different job roles, but also a tendency to perceive and interpret events in a similar manner, i.e. 'shared situation awareness[9]. The issues below are particularly relevant to promoting team situation awareness.

Role division

Individual and team roles must be defined clearly and understood by all. Individual roles should add up to a cohesive team. An important aspect of ensuring situation awareness amongst the team is that everyone has a shared understanding of who does what, allowing an event to be dealt with seamlessly. This is particularly important in an emergency when the CCTV room may be working under pressure. Effective job design/definitions and team training will support this mutual understanding.

Recommendations

- Job design should take account of human limitations in perception and decision making.

- Ensuring an overlap between shifts and encouraging operators to update each other on unresolved incidents (shift-changeover briefings) is an excellent way to reduce the possibility that team situation awareness may be lost.

Job

Shift changeover
Team situation awareness is particularly at risk of being lost during shift handover. Handover procedures should ensure that the incoming individual/team has sufficient and accurate information about events. It is therefore recommended that handover takes place within operators' paid shift periods. Situation awareness aids may include taking a screen shot of a suspicious vehicle, sketching a last location on a map or producing a bullet pointed summary of actions pending on open incidents. The particular tools and techniques which can be used in each control room will depend on their suitability for the context, data protection issues etc., but this is an activity for which CCTV operators may need additional support.

Status differences within a team
It may be presumed (correctly or incorrectly) that a manager should make the final decision, or it may be that an operator does not have the control necessary to execute the appropriate action, among other reasons. It is important that issues of status/hierarchy do not interfere with accurate decision making and actions, particularly during high stress situations.

Different locations
Team situation awareness can be lost when team members need to communicate with each other in different locations. This may be due to their different viewpoints of the environment, but other factors also predominate, such as differences in language used and levels of experience. As discussed in the chapter (training), it can be very beneficial to operate a policy requiring operators to regularly visit members of the team who are based 'on the ground' at the site being monitored, or even those in related agencies or organisations. Various teams working together should be using identical maps. **Map design** is covered later in this chapter.

Emergencies
In emergencies the priorities of the control room often change. Routine tasks may be put on hold, staff may work overtime or entire extra shifts and certain employees may even take on secondary roles in order to understand, plan for and resolve the emergency at hand. People may be less clear about who to contact with a given piece of information (because roles have changed), staff are likely to be suffering from fatigue and stress (due to working additional hours) and there may be high levels of anxiety which can affect how well people take in information and make decisions (i.e. human limitations – as described above – become more extreme). Training for emergencies will expose any areas of weakness (see chapter).

Recommendations
- Operators need appropriate tools to support the process of sharing information with each other during shift-changeover briefings.
- Mutual understanding of individual and team role boundaries can help prevent loss of situation awareness in many situations (including emergencies). Appropriate training should support this.
- Training and networking with 'external teams' can help promote and maintain good situation awareness.

Job

Trust

We tend to trust those people with whom we are familiar and those we perceive to be similar to ourselves.We also have a tendency to trust information only when we believe the source of information to be credible. It is possible therefore to have a piece of incorrect information that is received from a trusted information source, and to assume it is true. Conversely, information may come from a source considered to be unreliable, which is actually true – in which case it may be erroneously judged to be false. In both cases situation awareness would be hampered. Training and networking with other relevant internal/external teams can assist in building trust and promote accurate situation awareness – this could be vital in supporting the detection of criminal/suspicious activities occurring in and around monitored locations.

Design of physical work environment

This section considers more than simply the minimum and maximum levels at which humans can be exposed to heat, humidity, noise levels etc. but looks at the goal of comfort. It is true that people are adaptable creatures and can function in extreme conditions. However this does not necessitate that they function well and providing comfortable working conditions is an important part of supporting people in their work.

Environmental conditions
Heat and humidity

The human response to the thermal environment – heat and humidity – is affected by factors such as air temperature and velocity, clothing worn and activity level. This means that if physical activity level is to be altered, the temperature of the room may need to be manipulated to improve ability to work. Uncomfortable levels of heat and cold can negatively impact performance on tasks involving considerable mental processing, while cold tends to also reduce sensitivity of touch. These are tasks which are commonplace in most control rooms.

Measuring thermal comfort

The HSE defines thermal comfort as 'that condition of mind which expresses satisfaction with the thermal environment'. An index called the Predicted Mean Vote (PMV) is often used to measure thermal comfort where primarily sedentary work is carried out in the workplace (which includes measures of humidity, clothing and activity levels, etc) . The ISO (7730) suggests that the thermal conditions should keep the percentage dissatisfied or 'uncomfortable' at 10% or less.

Recommendations

- To avoid error and distraction, the ambient temperature of the control room should be suitable for the tasks that are carried out there.

Job

Light

As humans, our most relied-upon sense is our sight. Appropriate lighting is critical for visual work, which is a large component of the CCTV control room. Essentially when a task relies more heavily on vision, the effect of lighting plays a stronger role in task performance – it makes colours and details easier to discriminate and helps in preventing visual fatigue.

As we get older our visual ability declines; a 60 year old will need more light to see an object in comparison to an 18 year old. Age also results in a reduced ability to adapt to different light levels. The age range of employees is therefore an important consideration when designing lighting for a control room.

A key point for ensuring operators can use their eyesight to its fullest advantage is to make sure light is distributed to where people will need it most, i.e. at the centre of the visual field. However, it is not ideal to have wide variation in light levels across a room because the eye will need to adapt to the changes in light and will not function effectively until it has achieved this. If a large adaptation needs to occur, this can cause discomfort or glare.

Ways in which glare can be avoided are given below.

- Light sources should not be positioned immediately in front or behind the operator
- The use of movable lights or light diffusers can be effective for when there is a need for flexible lighting solutions
- Reflective surfaces should be avoided wherever possible
- Video display units should be placed at right angles to light sources (including windows).

Recommendations

- Variations in lighting level, as well as glare, can cause problems and should be controlled.

Job

Noise

The effects of noise on performance are dependent on the degree to which sounds need to be heard to complete a given task. Furthermore, not all noise is bad noise. Overhead speech is almost impossible to 'tune out' but research indicates that work-related conversations are 'good noise' because they can help to keep the team informed about important events (maintaining situation awareness), whereas overheard non-work related conversations are conversely 'bad noise' because of lack of relevance to the work of the team. Noise rarely affects visual or manual work, although it does usually affect tasks that involve a considerable amount of thinking and decision making. Consider the phrase 'I can't hear myself think!' In contrast, performance of routine, relatively simple tasks are typically unaffected by noise, in fact noise may even levy improvement.

Noise is a concept specific to the individual – some find silence more distracting than noise and what one person considers noise, another may not. This is important for understanding how to assess a control room for noise levels. Noise levels can be assessed with specialist equipment and training, however, unless hearing damage is a particular concern, questionnaires can give an indication of employees' reactions to typical noise levels (see HSE links in **further resources**).

Vibration

Short-term exposure to vibration has little significance for human health although long-term exposure can be damaging. It is unlikely that there will be vibration levels in the control room that may have a negative impact on this scale, however vibration can affect performance. This may be a problem in some control rooms; however issues with other environmental conditions are likely to be on a grander scale, depending on the equipment in use. Further information can be found about vibration by following the link in the **further resources** section.

Recommendations

- The perception of noise is individual – different sounds and volume levels are considered 'noise' by different people. Noise issues can be assessed by questionnaire.

- Overheard speech can be particularly distracting but overheard work-related conversations can aid work performance; the control of this type of noise should be dictated by task requirements.

Job

Equipment and technology

In this technologically driven society we have come to expect more from the technology we use. However financial budgets and tight timelines can cause technology to be installed without much thought to the people who will be using it in every shift – the end user. This section covers the issues that humans typically experience with key equipment and materials in the control room: monitors, cameras, camera maps and the overall layout of the workstation. The design of alarms and warnings to aid operator awareness is also referred to, along with User Centred Design as a practical method of getting equipment and materials to work for the benefit of operators (and therefore productivity).

User Centred Design (UCD)

UCD is a design process in which the needs, wants and limitations of the end user of a technology are given extensive attention at each stage. Participation in this process by operators as 'expert end users' can lead to better design solutions and a reduced resistance to the new system.

The ISO define four main activities necessary to follow the UCD process:

Specify the context of use

Consider the working context, the environmental conditions and characteristics of operators such as age, height, physical or learning disabilities, education level and existing knowledge of similar technologies.

Specify requirements

Understand the work that operators will do and what they need in terms of information and functions required.

Create design solutions

Early prototypes can be designed and be evaluated by experts and end users. Feedback is incorporated into a new design/prototype – this stage can be repeated as time and budget constraints allow.

Evaluate designs

Test the final solution in terms of the usability goals initially agreed.

User participation techniques useful for the first two stages are the production of word/mind maps and other visual materials such as drawings of one's own workspace. Questionnaires are useful for exploring the problem and evaluating the solution (the first and final stages).

In order to make a participatory programme successful, management support is essential and it may be necessary for the process to be facilitated and supported by a single 'champion'. For most control rooms it is envisaged that available time and resources for this may be limited.

Details of the relevant technological standards can be found in the **further resources** section.

Job

Workstation layout

By ensuring careful layout of workstations, employers can help to protect their staff from musculoskeletal disorders (injury, damage or disorder to the back or limbs), while also optimising productivity. Complaints from staff about lower limb or back pain/problems or headaches may be indicative of problems which need addressing.

Control rooms tend to feature more display screen equipment (or video display units) than other working environments. However, there is considerable guidance on how display screen equipment should be laid out,

length of use and the implementation of protective measures such as rest breaks and the Health and Safety (Display Screen Equipment) Regulations (1992), can be referred to (see further resources). Practical advice provided by the HSE[10] on how to comply with these regulations is featured in the box below.

It is worth noting that in control rooms where detailed reviewing of recorded CCTV footage is required – for example when retrieving forensic evidence – it is important that a separate dedicated workstation and monitor are provided so that routine monitoring operations and tasks are not affected.

Ergonomic research in work-station design has agreed upon a best-practice model which will keep physical load to a minimum for the typical video display unit operator

HSE advice on how to comply with the Health & Safety (DSE) Regulations (1992):

- Determine who is covered by the regulations (this will be people who habitually use display screen equipment)
- Assess workstations for risks and reduce them if they are found
- Ensure equipment, furniture, software and the work environment meet the minimum requirements
- Plan either changes of activity (which does not involve display screen equipment) or sufficient rest breaks are taken while undertaking DSE work
- Provide training and information, and if need be eye and eyesight tests for display screen users who request them.

Recommendations

- Workstation layout and scheduling of work involving display screen equipment should comply with the Health & Safety (DSE) Regulations (1992) and be specifically designed for minimising the risk of musculoskeletal disorders in the workforce.

Job

Controls and displays

Controls – such as keyboards, touch-screens, joysticks/trackballs, radio equipment, telephones and switches/levers etc. – should be laid out in order to meet task requirements and be within users' arm reach. Controls should be appropriately mapped to displays (usually visual displays such as monitors, and other indicators) in order to avoid errors – see below as an example. Displays and controls should also follow cultural conventions (e.g. in the UK the colour red signals danger, the "up" position indicates "off" for switches, a clockwise rotation of dials/knobs is associated with an increase in an input or output, while horizontal [linear] increments tend to move from left to right, or from bottom to top).
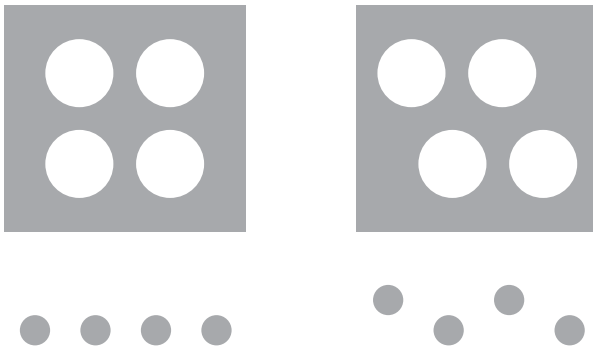
Stove top – which arrangement has better mapping of knobs (controls) to burners (displays)?

Screens and cameras

Cameras are essentially the CCTV room's eyes on the world. Good quality cameras and monitors, along with effective placement, will allow operators to observe the environment well and support their ability to understand the location and likely direction of targets during a dynamic incident – i.e. maintain 'spatial awareness'. Spatial awareness is an understanding of our location in space and the organisation of objects around us. What operators need to see in the environment will depend on their tasks, which should link to the operational requirements of the control room (see chapter).

Monitors

It is not possible to specify exactly what types of screens should be used in a given control room unless operational requirements are known. However, from an operator's point of view, good screen resolution and colour definition will help them to do a better job if fine visual detail needs to be discriminated. Screens with low refresh rates (50Hz or less) will cause the screen to appear to flicker, this should be avoided as it will cause discomfort to the operator. Viewing angle should also be considered with the operator in mind. Where new equipment is being sourced, it may be necessary to set up a workstation and test various specifications of monitor to determine which will support the operator with their tasks while providing value for money.

Recommendations

- Ideal specification and positioning of cameras is dependent on operational requirements but also on what an operator needs to complete a task successfully.

Job

Cameras

Cameras have differing capabilities and operational requirements will dictate which types of cameras are needed at various locations and, for example, whether they should be able to pan-tilt-zoom or capture high quality images at night. High definition cameras are excellent for zooming in and getting a very clear picture, which can be useful for when a particular person/object is being tracked or when photographic evidence is required. It is possible that several operators may all be looking at a fairly small area at one time, and only one operator will be able to have control of a camera at one time. Therefore for movable cameras, it should be noted that a camera left zoomed in or focused on other viewpoints may serve to potentially confuse the next operator as to what or where they are looking at. Spatial disorientation can easily occur when there is a lack of environmental cues. Fixed cameras always provide the same viewpoint, and while they lack adaptability, this consistency may help to support an operator's ability to locate and then track a target in certain circumstances. The CPNI currently recommend fixed cameras for use along perimeter fences and boundaries.

Camera placement

Camera placement can affect operators' spatial awareness; if the height of cameras varies considerably it can result in disorientation, especially for more inexperienced operators. Ideal camera placement for a particular site will depend on operational requirements. There may be particular 'hot spots' where lots of incidents take place, or other known threats to security. There may be vulnerable areas that are not so protected by fencing or access points which need to be surveyed at all times. Again it is advisable to involve the CCTV operators when considering changes to existing, or new, camera placement.

Camera maps and other maps

One of the key tools allowing CCTV operators to use cameras effectively is the camera map. A good camera map guides operators to select the best camera to view the scene and helps operators to learn camera positions more efficiently. Ideally the numbering of cameras on the map should follow a logical sequence and follow normal conventions (i.e. numbering sequences read from left to right or in clockwise direction). The camera map should represent what the operator understands about the reality of the environment. This does not always mean that the map will need to depict reality – for example the London Tube network map is very effective but it doesn't correspond very closely to the distances between stations.

Recommendations

- An effective camera map is recommended: this should use a logical numbering system and represent what the operator needs to understand about the reality of the environment.

- To avoid potential communication and operational problems internal and external teams should use the same site/environment maps.

Job

Other maps may be used in the control room to aid communication with someone who is in the monitored environment, such as a member of the public. Communication can be hindered when different parties have very different vantage points of an event. This can create issues in communication because different parties make assumptions about what each other can see, or they use very different reference points when referring to the environment.

3D maps can be used to help an operator locate landmarks and other features of the environment to aid communication with people 'on the ground'. However, for other tasks 2D maps may be more effective in terms of the operator understanding the layout of the environment. The choice of map will depend on the type of task to be done and characteristics of the site.

Alarms/warnings

Many control rooms make use of alarms – these are often auditory signals but can be visually indicated. Auditory alarms must use a frequency that is easily heard against background noise, without employing a loudness which could damage hearing. Visual warnings in contrast should stand out from their background with the use of colour, contrast, etc. The use of sound to convey a warning message can be particularly beneficial in a cluttered visual environment and where particular emphasis needs to be afforded to a serious hazard, as they tend to produce faster reaction times than visual warnings[11]. It is a good idea to ensure that a warning signals soon after the hazard arises and close to where the hazard either exists or is represented, as this will provide more information for the operator to act on.

The message auditory warnings convey needs to be short and simple. Typically auditory alarms are paired with a visual warning which directs attention to the source of the problem. Vocal and non-vocal auditory warnings have different benefits and disadvantages as they have the capacity to convey differing levels of meaning. However, the use of auditory warnings should be used to signal less frequent and more serious hazards, to avoid the problems associated with annoying operators. Furthermore operators will become habituated to a warning which they encounter frequently and will effectively stop reacting to it. Of critical importance is that

Recommendations

- The design of alarms and warnings should be carefully considered. People will only react to warnings based on trusted information.

Job

the warning system needs to be considered trustworthy and reliable in order to be of any benefit to the control room. User Centred Design (UCD) can be used to design a very effective warning system.

Designing for an emergency

There are many considerations to make when designing the physical control room for dealing with emergencies. Not all can be addressed here but two key issues of critical importance are explored below.

Discussion space

Each control room should include a space for group discussion and decision-making so that top level decisions can be made from the information derived by the team. It is possible that very lengthy debate will be necessary so the key to this room is to create not just privacy but comfort, which includes easy access to food and drink as well as consideration of all the physical environment factors addressed above.

Tools

While internet access is likely to be important for this particular group activity in emergencies, the room should not be set up with individual monitors that impede discussion. In contrast information sharing tools such as a large monitor and whiteboard are important for supporting people undertaking this kind of task. It should be remembered that the key goal of decision-makers at times of crisis is to consider information rather than to derive it, so the room and equipment should be set up to facilitate this.

Recommendations
- Additional physical working space and facilities should be considered for emergency situations where required.

Job

Mobile/home-based workstations

Another important point to consider is whether key members of staff (i.e. those that need to play a pivotal role in resolving a crisis) are set up to work from home if necessary. The critical components to concentrate on here are access to reliable communication systems and the relevant IT systems in use in the control rooms. There are various problems associated with communicating in any other medium than face-to-face. Trust of information from less familiar sources tends to be impaired which may negatively affect decision-making, but if properly designed, such human limitations can be addressed through the equipment and procedures which are selected to support the home-working. In addition there may be some need to contact key decision-makers whilst they are travelling, for example en route to the control room. Again the design of equipment and procedures is important in ensuring that people are protected from the additional risk associated with working on the move (such as driver distraction).

The main point here is that a control room dealing with a crisis is typically very different to one undertaking usual operations. It is critical that training, procedures, equipment, role definitions, etc., are set up to deal with this different mode of functioning. To test these issues it is also important to practise emergency procedures (see chapter – training) in the most realistic and representative way possible.

Job

Further resources

The Institute of Ergonomics & Human Factors is a resource for information on the application of human factors and ergonomics. They can supply details of specialist physical/environmental ergonomists. www.ergonomics.co.uk

General information sources, documents or techniques for assessing and managing risks in the physical and procedural environment are listed below:

- HSE five steps to risk assessment: www.hse.gov.uk/pubns/indg163.pdf

- Display Screen Equipment Legislation (as amended in 2002): www.legislation.gov.uk/uksi/1992/2792/contents/made

- Manual Handling Operations Regulations 1992 (as amended in 2002): www.legislation.gov.uk/uksi/1992/2793/made/data.pdf

- Amendments to this legislation made in 2002: www.legislation.gov.uk/uksi/2002/2174/contents/made

- ISO 7730 (2005) International standard: Ergonomics of the Thermal Environment-Analytical Determination of Thermal Comfort by Using Calculations of the PMV and PPD Indices and Local Thermal Comfort Criteria. International Standard Organization for Standardization, Geneva, Switzerland.

- ISO 9241 Ergonomics of Human System Interaction: a multi-part standard, which encompasses aspects of people working with computers. Part 110 provides a set of usability heuristics, and Part 11 provides guidance on how to measure usability.

- ISO 13407 (1999) Human Centred Design Process for Interactive Systems: a standard aimed at those managing the design process

- The HSE is a good source of information on assessing noise in the workplace: www.hse.gov.uk/noise

- The HSE have a noise exposure calculator that can help to estimate daily exposures: www.hse.gov.uk/noise/calculator.htm

- ISO (1999:1990). Acoustics – Determination of occupational noise exposure and estimation of noise-induced hearing impairment. International Standard Organization for Standardization, Geneva, Switzerland. http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=45103

- Further information about vibration can be found from the HSE website: www.hse.gov.uk/vibration/index.htm

- The Health and Safety at Work, etc Act 1974

- The Management of Health and Safety at Work Regulations 1999

- The Workplace, (Health, Safety and Welfare) Regulations 1992

- A leaflet by the HSE, entitled 'Workplace health, safety and welfare: A short guide for managers' which outlines the requirements of some of this legislation: www.hse.gov.uk/pubns/indg244.pdf

- The Working Time Regulations (1998) intended to implement: The Working Time Directive 2003/88/EC (a European Union Directive)

Individual

About this chapter
This chapter is about 'fitting the person to the job' – ensuring good job performance through the selection and training of operators. There is an extensive literature on the subjects of selection and training and only the essential points can be covered here. However, these are important issues which, in practice, are often overlooked for CCTV operators as a group in general – particularly investment in training. It is acknowledged that in some cases CCTV operators are selected and employed by third party contractors. Nevertheless, there may still be opportunities for CCTV managers to influence the appointment and training of these individuals.

Selection of CCTV operators
Selecting the right people for the CCTV operator role will help to maximise the motivation and job performance of the operator team. This section outlines some of the main selection issues relevant for this role. It does not cover legal matters (e.g. fairness and discrimination) nor advice on pre-employment security screening as the latter is provided on the CPNI website under Personnel Security.

Within larger organisations the recruitment and selection of personnel is often the responsibility of the human resources function. However, depending on the context, managers may exert a degree of influence on the selection process for CCTV room staff. CCTV roles will differ across sites, and the actual job requirements should flow from the organisation's goals and the operational requirements of the CCTV room – for example what emphasis is given to security monitoring, customer liaison, revenue protection etc. (also see chapter). In line with this, the selection process should begin with a suitable examination of what the role entails via an analysis of the job.

Job analysis
A job analysis is designed to produce systematic and reliable information about a particular role. It provides the basis for writing an accurate job description, will assist in developing a structured interview and serve as a basis for any selection tests which might be used (see below).

The aim of the job analysis is to derive a comprehensive list of job tasks, how they are carried out and the worker characteristics – aptitudes, skills and experience – which are necessary to perform them. As part of the analysis it can also be useful to indicate the relative importance of tasks in terms of priority for the organisation and frequency spent doing them. As well as covering the current role it is a good idea to consider how the job may change in the foreseeable future. Ways of conducting a job analysis can include:

- Observation
- Structured questionnaire completed by workers and/or supervisors
- Individual interviews
- Group interviews
- Participation

Individual

The organisation's human resources department may have a preferred method for carrying out job analyses. Alternatively, there are a number of generic job analysis questionnaires available on the market that can be used to analyse a wide variety of jobs; for the CCTV operator role (compared to say, a senior management role) the job analysis may not need to be very complex.

In many organisations the CCTV operator monitoring role is simultaneously combined, or rotated, with other tasks such as ground floor security guard activities, responding to customer queries, etc. The majority of operators work in teams. Therefore, as well as the cognitive abilities of vigilance and sustained attention required for monitoring cameras, the job analysis is likely to reflect aspects of these communications and team-based tasks.

Job description

Following the job analysis, a job description can be derived. Job descriptions start with the job's official title and then state how the job fits into the organisation, before listing the job's main tasks and responsibilities. Often a 'person specification' forms part of the job description and this lists the KSAs (knowledge, skills and aptitudes) or competencies that are desirable in the person who is to carry out the job.

A competency can be defined as the specific behaviours that the employee must demonstrate in order to perform the job task(s) to the expected standard. For example a key competency for a CCTV operator might be named 'customer service' and a behaviour underpinning this might be: 'actively listens to customers and tries to understand their needs'. For a 'team working' competency a positive behavioural indicator could be: 'treats other team members as equals and recognises people as individuals'.

Because CCTV operators work in a wide variety of contexts it is difficult to derive a definitive list of all the relevant competencies that would be desirable for the role. However, a suggested starting point is shown below[12].

- Knowledge of drills and procedures
- Operates all equipment competently
- Detailed knowledge of camera views and the camera numbering system
- Good geographical knowledge of the site(s) and premises to be monitored
- Makes appropriate decisions
- Assesses a situation accurately
- Works under stress and pressure
- Understanding of team goals, roles and responsibilities
- Anticipates colleagues' requirements
- Passes correct information to colleagues and external stakeholders at the right time
- Notices overloaded colleagues and supports them appropriately
- Thinks ahead and develops contingencies
- Ensures that colleagues maintain a shared understanding

As discussed earlier, CCTV monitoring staff may be tasked with other activities which are not directly related to monitoring and control of the environment (e.g. providing a customer information/service point, rotating tasks with ground floor security guards etc.). These would require additional skills and competencies.

Individual

Selection process

Once the job has been adequately defined, selection of candidates can begin. The interview is still by far the most widely used method of selection; however evidence suggests that the traditional 'unstructured' interview is not a particularly good predictor of job performance. Structured interviews have been found to be twice as valid (i.e. predictive of future job performance) than unstructured interviews[13]. Using the same interviewers throughout the process also improves interview validity.

In a structured interview, questions are structured (predetermined and scripted) and interviewers' judgements about the interviewee are indicated on rating scales or checklists. The questions included within a structured interview are derived from a detailed job analysis and are closely job related. Such a method helps to minimise potential interviewer biases from influencing the decision process and assists in making the process fair. If a structured interview is not feasible, then the use of two or more interviewers can obtain better results than just one in a conventional unstructured interview.

Psychometric tests

In some organisations it may be appropriate to supplement selection interviews with other methods of assessment such as psychometric tests. Tests fall broadly into two categories. The first category includes tests of cognitive ability such as aptitude tests and tests of general mental ability (for example numerical reasoning, verbal and non-verbal reasoning, visual-spatial abilities). The second consists of personality tests that aim to measure personal traits and preferences; for example a person who measures high on the trait of 'conscientiousness' is likely to demonstrate a reasonable level of persistence when performing a variety of tasks.

Many proprietary tests are available but it is recommended that the choice of appropriate tests for a particular job role is made by someone who has relevant training and expertise in test use (i.e. knowledge of how to assess the reliability and validity of tests and how to interpret the results). At the time of writing, the authors are not aware of a specific test that is predictive of good performance for CCTV operators working in a variety of contexts. A qualified person in the human resources department or external HR/psychometric consultancy should be able to provide best advice on test choice and implementation. Tests should generally only be used in conjunction with other selection methods to provide additional information for distinguishing between job candidates.

Individual

Training

This section comprises a broad outline of training practices and principles, together with some suggestions for relevant training content for CCTV operators. The aim is to provide a framework by which current CCTV operator training provision can be reviewed and/or designed rather than a comprehensive discussion of training design and delivery within the workplace; there are many publications available which cover these issues in detail[14]. The human resources department may be responsible for the training function but managers may have scope to influence training activities for their teams.

Where CCTV operators are employed directly by the organisation/site at which they work, there will be greater scope for influencing training in comparison to where the operator/guard force function is sub-contracted to an external organisation. However, contracted operators should have received at least basic training in CCTV. The Security Industry Association[15] website sets out the minimum required standards of training and certification for CCTV monitoring of members of the public in public spaces. A training review may indicate how CCTV operators can benefit from additional training relevant to the tasks they perform and to the organisation/site where they are deployed.

At the earliest stage it is advisable to gain organisational support for any proposed training. Following this, a common systematic approach for designing workplace training includes the following stages:

1 Training needs assessment

2 Design learning objectives

3 Choose learning environment

4 Evaluation

Individual

Training needs assessment

The assessment phase provides the information necessary to design the training programme. This requires a careful analysis of the job to be performed by trainees upon completion of the programme, and begins with specifying the tasks required on the job. If a comprehensive job analysis (using methods described earlier) has been conducted this can provide the necessary list of the skills and aptitudes, or competencies required to perform the CCTV job tasks. Following this an assessment of how well current employees are performing can be carried out using suitable criteria (measures of job performance).

Methods for carrying out the training needs analysis include interviews, observations, focus group discussions and questionnaires with job incumbents and other stakeholders. Existing job analyses/person analyses may not be up to date so it could be worth taking a current view of the job role.

Since the exact role of a CCTV operator will differ from organisation to organisation, detailed training needs will necessarily differ. However, as a minimum, it is recommended that training should cover the areas in the following list.

Suggested training for CCTV operators

- Relevant SIA training
- Induction into the CCTV role, CCTV team and the wider organisation
- Operation of all CCTV room equipment
- Detailed knowledge of camera positions and of the site(s) to be monitored – in practice this means getting out and 'walking the plot' wherever possible – including visits to remotely monitored sites.
- Knowledge of the current nature and level of security threat to the site(s) – CPNI can provide advice on this.
- Knowledge of the nature of unwanted or suspicious behaviours/incidents as they relate to the site.
- Team building with the immediate team.
- Understanding of the role of relevant external teams, agencies and/or networks. It can be beneficial to operate a policy requiring operators to regularly visit members of the team who are based 'on the ground' in the site being monitored, or even those in related agencies or organisations.
- Preparation for emergencies. Such training is often achieved using incident simulations / scenarios that attempt to model the conditions of a real emergency.
- An awareness of how human 'information processing' limitations affect what is detected and communicated amongst the CCTV and other teams – and tips for overcoming these limitations (see chapter at the end of this guide).

Recommendations

- Lists of suggested competencies and training content for CCTV operators are provided. Training should include relevant human factors issues.

Individual

Derive learning objectives

Once appropriate training needs have been established, it is usual to derive the specific learning objectives to meet each need. These are the objectives to be achieved by the trainee upon completion of the training programme and provide the input for the design of the training as well as measures of success (criteria) that are used to evaluate the programme afterwards. Learning objectives are usually stated in terms of observable behaviour for example:

"After training the CCTV operator will be able to operate all control room equipment"

Choose learning environment

Learning activities can be conducted in a number of ways – for example in a classroom, via job shadowing, one-to-one coaching within the role, or e-learning. Where the task to be learned is skill based, for example camera use, the individual should be allowed repeated opportunities to practise in order to become proficient. When choosing the learning environment, and designing and carrying out the training activities, it is important to consider the characteristics of the learners in terms of previous experience (and age), existing knowledge, educational background and motivation to learn. Training is unlikely to be received well, or be effective, if it is not tailored to the learning audience.

Evaluation

It is important to review how successful the training was in terms of what the learner has retained and the extent to which his/her performance in the role has changed as a result of the training. Techniques for evaluating training are a way of examining the success of training and identifying areas for training improvement. A popular framework for evaluation includes[16]:

Reaction – collecting data directly from trainees about their subjective responses to the training. This can focus on issues such as length of training, depth, pace, difficulty level, etc. It is advisable that this is collected immediately after training. At least some aspects of this process should be anonymous in order to encourage honest feedback.

Learning – what new knowledge has been acquired. This can be measured via a test or assessment (i.e. not just asking employees if they feel more knowledgeable).

Behaviour – a test here should assess whether the trainee can perform to the appropriate standard.

Transfer – this examines the extent to which the training has affected behaviour and results in the workplace.

Apart from these tangible benefits of training, an additional consequence of investment in training may be increased feelings of being valued by the organisation which can lead to increased motivation. This is important as, depending upon the culture of the organisation, security and/or CCTV functions are not always afforded a great deal of status.

Individual

Further resources

Threat
CPNI website
www.cpni.gov.uk

NaCTSO provides more information on the role of Counter Terrorism Security Advisors who can advise on threat and security.
www.nactso.gov.uk
The National Counter Terrorism Security Office (NaCTSO) is a police unit and forms part of the Association of Chief Police Officers (ACPO) Protect and Prepare. The unit is co-located within the Centre for Protection of National Infrastructure (CPNI.)

Selection
Cook, M. (2009).
Personnel Selection: Adding value through people.
Chichester: John Wiley.

Information on legal issues of selection is available on
www.gov.uk
www.acas.co.uk

Training
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Other information

Assessing workload

In general there are two types of workload: mental and physical. The majority of work in CCTV control rooms tends to be mental. Workload can be defined as the amount of work an individual has to do, the time available to do this in, and also the relationship between the amount of mental processing resources available and the amount required by the task. This last aspect of workload has similarities to stress because it involves someone's personal opinion about what requirements the task poses and what capacity he/she has available to dedicate to the task. In short, mental workload is largely a personal experience. Everyone has different talents which may affect how much capacity they have for satisfying task demands. Different people may also have different perceptions of what the task demands, due to their previous experience or assumptions about the task.

When people target workload they often consider the issues surrounding work overload, such as the worker becoming stressed, making mistakes and producing poor quality work. However work underload is also a problem because the tasks do not keep an individual engaged, which allows him/her to become bored, distracted and generally dissatisfied. Mistakes due to underload are common in workplaces where there is the need to carry out routine, repetitive tasks that essentially keep the hands busy but allow the mind to wander. As previously mentioned, the amount and type of work that overloads and underloads an operator will vary, and it will also vary within the operator as he/she becomes more proficient in a job role. It is therefore advisable to measure workload rather than to make guesses about the amount and type of work that is considered 'just right' to keep an operator relatively engaged.

Objective measures of workload (such as physiological and secondary task measures) can be difficult to implement without the relevant training, especially when subjective measures (e.g. questionnaires) can be better for understanding employees' perceptions with regard to workload. The NASA-TLX is one of the most accessible questionnaire tools for measuring mental workload, and it compares well to other measures. The questionnaire and an instruction manual can be accessed by following this link: http://humansystems.arc.nasa.gov/groups/TLX/paperpencil.html

Other information

Stress

Stress can be defined as the resulting emotional and physical response when a worker perceives he/she is unable to cope with the demands of a situation. Types of stressor found by researchers include: workload, work scheduling (time-structure of the working day), issues with the ambient conditions in the environment, work organisation, harassment and a lack of social support in the workplace, and having little control or autonomy over one's own work. There may be many other triggers, including events that occur outside of the workplace.

Stress can put both physical and mental health at risk. The kinds of physical health problems reported include: light-headedness, fatigue, headaches and raised fibrinogen levels (linked to the development of coronary heart disease). Mental health problems from severe stress of a lengthy duration include depression and exhaustion, and a psychological syndrome that has been termed 'burnout' . This results in severe fatigue, cynicism towards the job, and feelings of inefficacy, which tend to perpetuate further work stress and therefore increase the risk to mental health.

It is therefore important for the health and wellbeing of control room workers for sources of stress to be identified and dealt with. The Management Standards Indicator Tool , is a questionnaire method that enables stress to be measured amongst a group of people (although less suitable for in-depth investigation of particular individuals). The aim of this HSE tool is to provide an organisation-wide model which is designed to aid the identification of stressors, determine who is most at risk of harm and how to take action on these risks. Further information on stress in the workplace can be found on the HSE website: **www.hse.gov.uk/stress**

In terms of general ways to protect workers, social support from both co-workers and supervisors is key to providing a 'buffer' from the negative effects of stress – in fact low levels of social support may be a risk factor for poor health in itself. In addition workers can help to protect themselves by developing effective coping strategies. These are 'healthy' ways to deal with emotions arising from stress and resolve the stressful situation itself.

Other information

Human limitations
Limited short-term memory
We are limited in how much information we can process at any point in time. Tasks that require similar types of processing (e.g. listening to speech and reading, or two tasks that both need visual processing) are particularly problematic.

Overloading an operator with too much information, particularly during critical tasks, should be avoided. Design of systems and computer interfaces should take this into account.

Limited attention
Aspects of a situation must be attended to (noticed) for them to contribute to situational awareness. However, humans have limited attention capacity.

Procedures, tools and technology can be designed to help draw attention to the most critical aspects of situations – if these are well known. Auditory alarms for example can be an excellent way of ensuring attention is paid to a particular urgent aspect of a situation, whereas a high workload can restrict attention.

Visual limitations
We like to believe that our vision works like a video camera, that our eyes capture things as they are in reality and if there is any detail we have missed, this is just because we have not managed to recall it properly after the event. This could not be further from the truth. Actually what we 'see' in the environment is greatly influenced by our experience of the world, how we have come to understand it and what we expect to see in any given scenario. The message to take home is that what we see is somewhat personal and fallible. A CCTV operator therefore cannot be expected to see everything that he/she monitors. It is often assumed by those outside the control room that the CCTV capability is essentially an 'all seeing eye' which is actually an overestimation of both control room capacity and human ability.

To overcome issues of inaccurate visual memory, and to maintain accurate situational awareness, it is important that details of potentially suspect persons or vehicles are logged immediately.

For tracking detected targets from camera to camera it may be helpful for two or more operators to work together and/or to 'manually' follow the position of the target with a finger on the monitor or place a temporary physical mark on the screen.

Confirmation bias
In any particular situation, people tend to look for information which confirms their prior beliefs and they also interpret information in a way that is consistent with their preconceptions – evidence that does not fit with existing beliefs tends to be ignored or explained away. This is known as 'confirmation bias'.

Confirmation bias is best combated through team training and introducing best practice procedures that encourage evidence to be examined by operators in a non-biased way.

In the context of a CCTV control room this may translate as the operator seeking the opinions of others when something or someone suspicious has been identified. However it is important that the operator refrains from communicating what his/her initial assumptions about the object or person were at the outset, otherwise the confirmation bias may spread. This means asking an open question, such as – 'What do you think of this?' rather than a leading one – 'What do you think that shifty man is plotting with his camera phone?'

Other information

Human limitations

Stereotyping

Stereotypes are generalisations about others (often members of groups that are not considered to be one's own), which reflect beliefs and expectations about their personal characteristics and behavioural tendencies. They tend to be simplified and they can be derogatory, although they are not necessarily always inaccurate. Stereotypes tend to be slow to change because people usually seek information that confirms rather than disconfirms a stereotype (see confirmation bias above).

Stereotypes can influence what CCTV operators notice and recognise as suspicious behaviour, which may lead to false identifications or missed opportunities for prevention.

The key to reducing the effect of stereotypes on information gathering and decision-making is to recognise their presence (we all have them) and focus on the behaviour as well as the appearance of the person.

Pre-existing knowledge/beliefs

The way in which people perceive and interpret information is affected by their mental models. A mental model is basically a personal understanding of how something works in the real world based on learning and past experience – such a representation can be accurate or inaccurate. Mental models contain information that is in actuality very difficult to pass on in its original state. This is because much of the knowledge is implicit and therefore difficult to verbalise in comparison to explicit knowledge. It may be sensed as 'gut instinct' or possibly not acknowledged at all. However, the development of good team (shared) situation awareness is facilitated by the sharing of these representations with those with whom we work.

A good way to foster team situation awareness is to provide the optimal conditions for team building and interaction, such as team identification of roles and a shared understanding of individuals' roles within the team. Encouraging knowledge sharing through such techniques as job shadowing will also facilitate the sharing of mental models.

Other information

Recommendations

Organisation

- The CCTV Control room should be set up, or redesigned, according to a CCTV operational requirements plan and the CCTV room staff, as end-users, should participate in this process.

- The CCTV control room function and its operators should be visibly and actively supported by all members of the organisation, particularly by senior management.

- CCTV first-line leaders (supervisors/managers) should be appropriately trained in order to support and motivate their team.

- The CCTV operators' role should be supported by effective performance and appraisal systems.

Job

- Individual jobs should be designed to promote job satisfaction – this can be achieved by altering job characteristics rather than focusing on financial remuneration.

- The dynamic workload of individual operators should be assessed in order to avoid work overload and underload, as these can lead to stress and/or human error.

- Automated processes and alarms (that enhance/replace operators' tasks) can be time-saving but it is critical that operator control can be quickly resumed if required and that systems are reliable and not prone to false alarms.

- Human attention span is limited and tasks that require intensive sustained vigilance such as monitoring CCTV feeds for critical security breaches should be covered in brief shifts of around 20 minutes.

- Shift-patterns are often designed to meet commercial and operational requirements but serious consideration should be given to minimising negative effects on health and well-being by the use of appropriate shift patterns.

- Where feasible operators should be able to exercise some control in choosing a shift pattern that suits their individual circumstances as this can help reduce negative effects.

- Job design should take account of human limitations in perception and decision making.

- Ensuring an overlap between shifts and encouraging operators to update each other on unresolved incidents (shift-changeover briefings) is an excellent way to reduce the possibility that team situation awareness may be lost.

- Operators need appropriate tools to support the process of sharing information with each other during shift-changeover briefings.

- Mutual understanding of individual and team role boundaries can help prevent loss of situation awareness in many situations (including emergencies). Appropriate training should support this.

- Training and networking with 'external teams' can help promote and maintain good situation awareness.

- To avoid error and distraction, the ambient temperature of the control room should be suitable for the tasks that are carried out there.

- Variations in lighting level, as well as glare, can cause problems and should be controlled.

- The perception of noise is individual – different sounds and volume levels are considered 'noise' by different people. Noise issues can be assessed by questionnaire.

- Overheard speech can be particularly distracting – but overheard work-related conversations can aid work performance; the control of this type of noise should be dictated by task requirements.

Other information

Recommendations

Job

- Workstation layout and scheduling of work involving display screen equipment should comply with the Health & Safety (DSE) Regulations (1992) and be specifically designed for minimising the risk of musculoskeletal disorders in the workforce

- Ideal specification and positioning of cameras is dependent on operational requirements but also on what an operator needs to complete a task successfully.

- An effective camera map is recommended: this should use a logical numbering system and represent what the operator needs to understand about the reality of the environment.

- To avoid potential communication and operational problems internal and external teams should use the same site/environment maps.

- The design of alarms and warnings should be carefully considered. People will only react to warnings based on trusted information.

- Additional physical working space and facilities should be considered for emergency situations where required.

Individual

- The selection of CCTV operators should follow a formal process and be based on a sound analysis of the job tasks.

- Job competencies and tasks should be derived from the function requirements of the control room.

- Training is important for motivation and performance and should be designed to meet operational needs.

- Lists of suggested competencies and training content for CCTV operators are provided. Training should include relevant human factors issues.

Other information

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