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Key Factors of Efficient Operator Activities

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Abstract

Aim: The study aims to explore the role and significance of human factors and cognitive processes in the operator activities of surveillance systems.
Methodology: The authors discuss important human factors related to effective video surveillance and the environmental conditions necessary for efficient work, drawing observations from various research studies and standards.
Findings: The sensory, perceptual, and attentional abilities of the operator have a significant impact on the quality of their activities. The efficient operation of surveillance systems largely depends on the operators' intuition, expertise, and the appropriate work environment.
Value: The study contributes to a better understanding of the role of human factors in video surveillance systems and allows us to formulate guidelines and recommendations that can improve the efficiency of operator activities.

Keywords: Operator activity, Perception, Continuous attention, Video surveillance systems

Introduction

Despite the many cameras and the continuously increasing image resolution, if no personal/technical background processes the generated information and executes measures when events are recognised. In the control centres of surveillance systems, alongside the increasingly prominent role of artificial intelligence, the

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human factor is still a key player in operations. Operator activity provides a rich context for research on visual attention, search, observation, and perception, as it encompasses tasks that are dynamically changing and sometimes require simultaneous observation of multiple cameras. The operator needs information spanning multiple spatial and temporal scales for continuous monitoring. They analyse and track the spatial and temporal locations of individuals and vehicles and examine and identify their activities. Intelligent video surveillance systems are capable of improving situation awareness, however, despite the advancement of intelligent technologies, the role of human operators remains significant in perception and decision-making. Therefore, it is important to understand the cognitive processes involved in observation and perception.

Perception and Sustained Attention

The perceptual, cognitive, and attentional capacities of the operator have a significant impact on the quality of their activity. The difference between perception and sensation originates from the level of processing: during sensation, we react to simple stimuli, while perception essentially means consciously processing the information and stimuli (e.g., objects, events, sounds, etc.) acquired from the environment through the senses. Various factors influence the quality of perception, such as the characteristics of the perceiver: their past experiences related to the perceived stimuli, their needs, and motivations, as well as the perceiver's personality, values, and attitudes can also affect the perception process. In addition, the characteristics of the object of perception (such as events, objects, people) (e.g., size, movement, intensity, familiarity) can be important influencing factors, and the characteristics of the context should not be overlooked.

Human perception does not exactly reflect reality. Experiences, surroundings, as well as a person's beliefs and objectives, all impact the way the brain interprets information from the senses. Past experiences can distort our perception by 'priming' our sensory systems to perceive certain objects and events, and by priming them not to perceive other objects and events. Repeated perception of an event over a short period can lead to habituation, increasing the likelihood of missing subsequent occurrences of the event. Through experience, we develop preconceptions that are more pronounced in familiar situations, thus distorting the perception of reality. It is worth highlighting the concept of the so-called absolute threshold or sensory threshold about perception, which refers to the smallest stimulus that the sensory organ is capable of perceiving (Dúll, 2001). This varies from individual to individual and can depend on the individual's motivation and physical condition. Our sensory organs become accustomed to stimuli over time, therefore, the quantity of stimuli needs to be increased for the stimulus to be perceived. This process is called adaptation, the habituation to stimuli (Dúll, 2001).

Perception and attention are closely interconnected. Before delving into this relationship in more detail, it is important to interpret the concept of attention from the perspective of operator work.

In its most general form, attention[1] is simply the general level of alertness or the ability to interact with the environment. Attention is a cognitive process that allows us to select relevant stimuli and focus on them. Sustained attention control (commonly known as concentration) is the ability to sustain selective attention on a task for an extended period while resisting internal and external distractions. Continuous attention control is important during the monitoring of images in surveillance systems. The nature of sustained attention control is also determined by genetic factors (Fan, Wu, Fossella & Posner, 2001), but factors such as childhood traumas, (Banz, Wu, Crowley, Potenza & Mayes, 2016) can negatively impact it during development, while factors like physical exercise and computer games can have a positive influence. (Diamond & Lee, 2011) Attentional control is a skill, therefore, it can be improved through various techniques (Debreczeni, 2012). The search on the differences between genders in sustained attention regulation is incomplete. According to some research, gender has no bearing on sustained attention (Chan, 2001), while others argue that men have higher vigilance[2] (Blatter, Graw, Mirjam, Knoblauch, Wirz-Justice & Cajochen, 2006), and women exhibit increased inhibitory control[3] (Yuan, He, Qinglin, Chen & Li, 2008). The level of vigilance varies in different phases of the sleep-wake cycle, in individuals undergoing sleep deprivation, or under the influence of sedatives. The level of alertness in a tired, drowsy person is noticeably worse compared to someone who is well-rested (Makeig, Jung & Sejnowski, 2000). The purpose of proactive systems is the early detection of illegal activities and preferably the prevention of their realization. The proactive use of surveillance systems without image analysis software places the heaviest burden on operators. In this case, proactive monitoring occurs in real-time, excluding any image analytics or other decision-support systems that could assist the surveillance personnel's work. In such situations, the task of

1 According to the clinical model of attention, there are five different types, namely focused, sustained, selective, alternating, and divided attention.

2 Vigilance is closely related to attention. The word attention is often used when defining vigilance. Vigilance can be understood as the degree of readiness to perceive essential stimuli for safety or the probability of perceiving them.

3 Behavioral control, self-regulation is a manifestation that allows individuals to control inappropriate behavior in certain contexts.

perception-decision-action falls on the operator. Continuous, real-time monitoring of cameras may require greater sustained attention and cognitive resources, as well as specific individual traits, such as a higher tolerance for uncertainty[4] and monotony. In the process of building a video surveillance system, one crucial factor to take into account is the number of monitors that an operator will be able to watch at once. Tickner and Poulton examined the limits of the number of video images that could be effectively monitored simultaneously in 1972 (Tickner, Poulton, Copeman & Simmonds, 1972). The study made many interesting findings. During the supervision of 16 monitors, each displaying a single camera image, perception is more effective when there is less activity on each monitor image. The recommended duration of work is a maximum of one hour. Suspicious incidents were more likely to be missed if they occurred for a short time or in a small area of the image. Similarly, observation was disrupted if other activities (such as making phone calls) were carried out simultaneously.

Reducing the size of the images leads to a decrease in event detection. Operators who had previously engaged in such activities were more effective than those who had not. An operator can effectively monitor[5] the images of up to 16 cameras continuously, but in cases where there is high activity in the images, the number of monitors to be supervised was maximized at nine[6]. In the case of monitoring a large number of cameras, it is common practice for operators to select a few familiar camera images to monitor through a work monitor, thereby paying less attention to the camera images on the other monitors (Stainer, Scott-Brown & Tatler, 2013).

The decision on which camera to focus on is typically based on the operators' expectations, i.e., where incidents are expected to occur. Although it is easier to predict the occurrence of certain types of incidents than others (for example, a fight is more likely to occur outside a nightclub on the weekend than during the week, unlike a theft at a bus station, which can happen at any time), there is a margin of error in selecting the cameras to focus on and the monitoring and search strategies employed. The number of cameras observed simultaneously likely influences the visual scanning patterns and the search strategies used within the cameras. The operator's ability to monitor multiple cameras at once is not solely dependent on the number of cameras. For example, the information load

4 Uncertainty can arise regarding when, where, and what potentially important event will occur. This likely influences the search strategy as well.

5 It can vary depending on the context, and operator competence can also influence it.

6 The number of cameras per operator varies depending on the application area. For example, fewer cameras are assigned to an operator in areas where theft prevention and detection are considered crucial, and where incidents occur quickly and are difficult to detect.

and the importance of information for the task influence the operator's capacity for simultaneous monitoring (Stainer, Scott-Brown & Tatler, 2017). Perception is easier in stationary images and in situations where behaviour is normal and predictable. (URL1). If the images change rapidly and unpredictably, even if there is no incident, monitoring likely requires more attentional resources (Tickner, Poulton, Copeman & Simmonds, 1972). An example of this could be a continuously scanning dome camera. Some significant events are identified based more on the semantic context or understanding of their meaning rather than visual characteristics, requiring contextual knowledge and interpretation for perception.

In the field of cognitive psychology, numerous scientific works explore the interaction between attention and perception (Meyer & Kornblum, 1993) (Posner & Marin, 2016) (Pashler, 1999) (Richards, 1998). Without the basic perception of an object, it seems impossible to pay attention to it (Treisman & Geffen, 1967). When people are engaged in tasks that require focused attention (such as focusing on specific details on the screen), they often do not notice other unexpectedly appearing information on the display. In the 1970s, Ulric Neisser and associates conducted the first empirical investigation of this phenomenon (Neisser & Becklen, 1975). Through the study by Mack and her colleague, Rock (Mack & Rock, 1998) the term 'inattentional blindness' entered discussions related to attention. In addition to inattentional blindness, there is also the phenomenon of change blindness, which refers to the lack of detection of unnoticed changes (Csépe, Győri & Ragó, 2007), i.e., the inability to perceive minor changes occurring within the visual field. his occurs when an individual fails to notice a change in something they are actively observing.

Operators are greatly exposed to both inattentional blindness and change blindness. It is important to mention that inattentional blindness is not dependent on how much visual information a person can attend to or maintain, and it cannot be predicted by an individual's visual working memory capacity, (Hannon & Richards, 2010) functional visual field, or ability to track multiple objects (Memmert, Simons & Grimme, 2009). In specific event searches, inattentional blindness is more likely to occur when the observer's cognitive attention is focused on finding a specific type of activity, thus excluding other significant events.

Due to the limited capacity of our attention, in cases of overload, we may encounter various errors in visual awareness. With rapidly occurring consecutive stimuli, we may skip events, leading to what is known as an attentional blink[7]

7 Attentional blink is a phenomenon that reflects the temporal limits of the ability to capture visual attention. It occurs when people have to process two visual stimuli quickly in succession (within 200-500 ms). The processing of the first stimulus blocks the reception of the second stimulus.

(Johnson, 2014). Inadequately determined monitor count is one factor that might lead to overload. If there is activity on every monitor, this can quickly overwhelm the operator's attentional capacity. To avoid this, operators need to achieve heightened attentional focus while operating attentional filtering processes. However, this filtering process often relies on social stereotypes to determine who the target individuals are, which carries the risk that the operator may not notice abnormal actions carried out by non-stereotypical perpetrators. (Norris, 2002).

Intuition

The efficiency of operating surveillance cameras depends largely on the methods employed by the operators. In conversations with operators of public surveillance systems aimed at gathering information on factors that could lead to more effective recognition of criminal activities or abnormal behaviour, intuition was often mentioned as a factor.

Intuition is a process that enables us to directly perceive something without analytical reasoning, bridging the gap between our conscious and unconscious mind, as well as between instinct and reason. Intuition is a form of knowledge that appears in consciousness without apparent deliberation. It is not magical; rather, it is a capacity in which the unconscious mind quickly sorts through prior experiences and body of knowledge to produce hunches. Intuition, often referred to as 'gut feelings,' generally emerges holistically and quickly without awareness of the underlying mental processing of information. The ability to recognize deviant behaviours often relies significantly on expertise and sometimes on intuition.

One defining characteristic of expertise is that individuals proficient in operating surveillance systems possess more elaborate knowledge structures than beginners and are capable of handling tasks at a metacognitive level. One advantage of intuitive decision-making by more experienced individuals in system operation is their ability to make better decisions in stressful situations. In such situations, people tend to refrain from applying more thoughtful cognitive strategies and instead rely on their experiences. 'Our intuition may also be more reliable in complex situations when time is limited: In those situations, our conscious processing skills -located in our working memory-simply may not be capable of handling the complexity or the number of factors that need to be quickly weighed' (Zimbardo, Johnson & McCann, 2012). Experience and information gathered during learning and training can help develop intuition, as more information is available in our unconscious mind. The more experience we gain, the better we can intuitively react to certain situations.

Unfortunately, in Hungary, there is no system of requirements or tailored training for operators. In contrast, operators in the United Kingdom, for instance, are required to complete standards-based training and are only permitted to operate with a licence granted by the Security Industry Authority (SIA), a body officially established by the UK Home Office (Tóth, 2023).

Expertise skill

Each event representing the formation of actions involves one or more relevant objects that interact with each other. In the case of wide-angle camera images and significant crowds, controlling existing multiple activities and detecting behaviour that deviates from the norm in this context is a complex task. In proactive surveillance, the expected goal is for operators to recognize deviant behaviour and intentions of misconduct/criminal activity. Whether an action is deviant or not depends on how society and the law define the particular behaviour. Deviance is not an internal (biological or psychological) attribute of individuals or the actions themselves but a product of social processes[8]. The norms themselves or the social contexts that declare which actions are deviant or not are determined by variable social, political, legal, and cultural processes and are continuously redefined. Every society exercises social control, regulating and enforcing norms. Social control can be broadly defined as organized action 'aimed at changing people's behaviour' (Innes, 2003). The fundamental purpose of social control is to maintain social order, the arrangement of practices and behaviours on which members of society base their everyday lives. Accordingly, operators need to perceive and recognize deviations in behaviour that indicate pre-criminal conduct. Essentially, we can classify behaviour that deviates from the norm into two different groups. One is when the behaviour itself is abnormal or conspicuous. Types of criminal intent, such as terrorism, theft, pickpocketing, begging, or aggression, can be associated with different forms of behaviour and situational characteristics, making them relatively easy to recognize. The other is when behaviour deviates from the expected behaviour in a given situation. What may be normal in one situation may be deviant in another. Deviant behaviour is behaviour that violates the norms prevailing in a particular time and place.

8 Social processes refer to interactions and relationships between individuals and groups, which impact society. Social interaction characterizes the social process, in which individuals and groups act and react in social situations.

For operators to work effectively, they need to be familiar with specific forms of behaviour associated with criminal activities, but they also need to know what is considered normal behaviour in different settings. If operators know both deviant and normal behaviour, they can more effectively recognize subtle differences in behaviour. There can be an overlap between normal and deviant behaviour. For example, wandering in a parking lot could indicate a car thief, but it could also be someone who forgot where they parked their car. Wandering itself is not deviant behaviour, but with careful observation and consideration of circumstances, it can be classified as such in a specific context.

Another important factor for efficiency is how operators select from the wide range of available camera images the one they will observe more closely. One possible answer is that this selection is based on reacting to unfolding events in individual images. Another is when proactive observation dominates. In this case, the selection criteria are likely strategic, based on prior knowledge and expectations. Operators are aware of the events expected to occur at different locations at various times, and based on this, surveillance focuses on camera images monitoring these locations. The question is how these spatial and temporal expectations develop in the individuals performing surveillance. One answer is through experiential learning, shaped by practice. Another is through learning or through time spent in similar positions, which develops these abilities.

Communication

Communication plays a significant role in various aspects of operator work. Firstly, we draw attention to the importance of nonverbal communication. Depending on their complexity, human activities can be divided into four different levels: gestures, actions, interactions, and group activities. Gestures are elementary movements of a part of the body that describe a person's movements based on the elementary components of their body. Each movement of the body, such as raising a hand, represents an intention or thought and is a good example of the concept of gesture. Action refers to a movement created by a person, consisting of two or more temporally organized gestures, such as running or hitting. Interactions involve two or more people and/or objects and include behaviours such as hugging between two people or interaction between a person and an object when someone picks up an object. Group activities consist of activities involving multiple people and/or objects, such as a group meeting, or group violence in public spaces, such as a fight between two groups. The aim of this study is not to analyse the complex nonverbal channels in detail but to emphasize that knowledge of nonverbal communication channels is essential for operators in their work.

Communication and interaction between operators and responding personnel are essential for the successful operation of a surveillance control centre. Developing basic procedures to avoid conflicts, defining roles and responsibilities, and creating an environment where people feel they are working together towards a common goal are necessary. The quality of communication between operators and responding personnel also influences the likelihood of successfully apprehending perpetrators. The operator's ability to convey information about the perpetrator, the event, relevant reference points for orientation, and the environment is crucial for success. Experience and street interventions can help operators convey understandable and necessary information to their colleagues. The task and responsibility of the operator is not only to respond decisively and promptly to incriminating events but also to assist and protect the responding personnel. This primarily involves providing accurate information about the surroundings, which can affect how patrol colleagues should react or what types of activities would be most appropriate for the circumstances. Adequate communication can help maintain the reputation of patrol colleagues on the scene in situations where assistance is needed to make the optimal decision, and it can also help prevent reckless actions such as corruption, physical abuse, etc., with central control.

External factors influencing the manifestation of human factors

Creating a proper ergonomic work environment is essential for the effective performance of human factors. The environment of video surveillance system operators is directly related to their work performance and plays an important role in sustaining prolonged attention. Various factors in the work environment, such as temperature, noise, and lighting, have a significant impact on people's attitudes, behaviours, and overall well-being. A well-designed surveillance room accommodates the operators' physical needs while allowing them to make critical decisions in a fraction of a second. Conducting an ergonomic risk assessment is important for creating the appropriate work environment and complying with regulatory requirements. During planning, design, and operation, it is advisable to consider the series of standards titled 'Ergonomic design of control centers' ISO 11064 and decree 50/1999. (XI. 3.) EüM on the minimum health and safety requirements for work at display screens[9].

9 50/1999. (XI. 3.) EüM decree on the minimum health and safety requirements for work at display screens.

Temperature and humidity

Factors including clothing worn, activity level, air velocity, and temperature and humidity all affect human thermal comfort. Uncomfortable levels of heat and cold reduce comfort can negatively impact performance in tasks requiring significant mental processing, while cold generally reduces tactile sensitivity. The highest efficiency is achieved at a temperature around 22°C, whereas at a temperature of 30°C, for example, performance is only 91.1%, resulting in a decrease of 8.9% (Seppänen, Fisk & Lei-Gomez, 2006). Increased humidity generally increases the perceived temperature level. For seated activities in winter conditions, the recommended temperature should be between 20°C and 24°C, and the temperature difference between the head and ankles (at heights of 0.1 m and 1.1 m) should not exceed 3°C. In the summer, the recommended temperature range is between 23°C and 26°C, with the temperature difference between the head and ankles remaining at 3°C. The recommended humidity level is between 30% and 70%.[10] It is important to consider that the IT units and monitors placed in observation rooms generate heat themselves, making it almost unavoidable to use air conditioning in warmer summer periods. It is crucial to ensure not only air cooling but also the supply of fresh, oxygen-rich, clean air. The speed of air movement should not exceed 0.15 m/s. Excessive air velocity can cause joint problems, muscle pain, as well as eye irritation, and itching. In my survey in Hungary, 5% of observation rooms did not have air conditioning units.

Illumination

Proper illumination is crucial for the visual work carried out in a video surveillance centre, as a significant portion of activities related to data processing are done by the human visual system. Various lighting factors (such as intensity and colour temperature) directly influence individuals' visual and cognitive performance (Hawes, Brunyé, Mahoney, Sullivan & Aall, 2012). Windows and the natural light they provide improve the mood and help combat fatigue. The disadvantage of windows is the difficulty in regulating incoming natural light, so attention should be paid to blinds, shades, room layout, and the arrangement of workstations and equipment during design and implementation. The layout of monitors should be designed in a way that prevents sunlight from causing glare

10 The values for temperature and humidity are recommended by the MSZ EN ISO 11064-6:2006 standard, which is based on the requirements of the MSZ EN ISO 7730:2006 standard.

on the screen. Natural lighting is not distracting when monitors are placed in less illuminated parts of the room. Similarly, artificial lighting should be adjustable. The lighting should not be too strong to ensure that images on the screen have sufficient contrast, and reflections on the walls, doors, furniture, and documents in the room should be minimized. Avoid large differences in light levels, as the eyes need to adapt to changing light conditions, and excessive adaptation can cause glare. The difference in ambient lighting values directly between the screen and its immediate surroundings (keyboard, desk) should not exceed a ratio of 1:3, while the ratio between the measured value at the screen and the ambient lighting in the more distant environment (room) should not exceed 1:10 (Quintana, Lizarazo, Bernal, Cordoba, Arias, Cotrino & Montoya, 2012). The appropriate local illuminance can be achieved with adjustable desk lamps. The standard MSZ EN ISO 11064-6:2006 recommends a maximum ambient illuminance value of 500 lux for video surveillance rooms equipped with monitors.

Noise

The impact of noise on performance depends on the extent to which sounds need to be heard to perform a particular task. Generally, higher noise levels can result in lower levels of alertness, reducing efficiency. Not all noise can be considered harmful. Communication related to work can help with collective work and ensure proper information flow. Noise is a subjective concept - some find silence more disturbing than noise, and what one person considers noise, another may not. Maintaining a lower level of background noise is important for understanding conversations with colleagues or through communication devices. IT equipment should preferably be kept in a separate room or in a rack cabinet made just for that purpose in order to minimise the background noise it produces. Noise can also be reduced by selecting appropriate wall and floor coverings, as well as curtain materials.

Vibration

Short-term vibration exposure is not significant for human health, but long-term exposure can be harmful and affect performance. High-intensity and frequent vibrations can cause fatigue, muscle cramps, joint pain, and sensitivity, which can reduce work efficiency. Generally, in the case of a video surveillance center, we do not need to consider this factor. However, in certain cases, such as construction near the central room temporarily or surface or underground mass transit vehicles, this type of issue may arise persistently.

Workstation layout

During design and operation, it is advisable to consider the standard 'Ergonomic design of control centers' MSZ EN ISO 11064-4:2014 and decree 50/1999. (XI. 3.) EüM on the minimum health and safety requirements for work at display screens. Careful design of workstations can protect employees from musculoskeletal disorders (such as back or limb injuries, and pain) while optimizing efficiency. Ergonomic design is essential for this specialized environment. Operators should sit in a way that their hands, wrists, and forearms are straight, aligned, and parallel to the floor. The horizontal plane of the head nod should be level, looking forward without turning left or right, and in line with the torso. Cheaper office chairs are less suitable for areas where long periods of sitting work are required. Unlike typical office chairs, operator chairs in a central monitoring room are in use 24/7, and there is less opportunity for breaks in this role. People of different heights, weights, and body types can use them. Therefore, the expectations for 24-hour workstation chairs are higher than for average work chairs. They should be durable, well-padded, and offer a variety of adjustment options. The ergonomic chair provides high-level support for the back, allowing for adjustment of seat height and tilt angle for any body type. The headrest can help alleviate neck strain when looking at the screen. Proper placement of various controls, keyboard, and mouse configurations is also an important ergonomic factor. If operators reach for the control device in a poor posture or do not consider the parallel requirements for elbows and wrists, their so-called 'natural position' is lost. Handling input devices in this way can lead to fatigue and, after prolonged exposure, strains, or injuries. Monitors and other display devices should be positioned directly in front of the user. Prolonged viewing of the screen should not require excessive strain on the neck muscles. Ergonomic design requires that individuals do not have to turn their necks left, right, up, or down to view the screen. This principle applies to both single and multiple display setups. The design should also consider the optimal viewing distance for monitors. The distance is influenced by many factors, such as the size of the monitor, resolution, and the individual's vergence[11] value, which has a greater impact on eye strain than the resting point of accommodation[12]. The resting point of convergence changes with the viewing angle. The smaller the viewing angle, the closer the resting point of convergence moves (Ankrum,

11 The closer an object is, the more the extraocular muscles converge the eyes towards the nose. The eyes also have a resting point, which varies individually but is around an average of about 1 meter.

12 The adaptation of the eye to distance.

1996). Distance is a critical factor that affects perceptual performance and fatigue resulting from prolonged viewing. There are not many studies available on monitor viewing distances, and the results obtained are not consistent. In his 1959 publication, Enoch suggested that the best viewing distance should be 6.25 times the width of the screen. (Enoch, 1959). A study released in 1963 by the University Facilities Research Center at the University of Wisconsin suggested that this value should be a minimum of 5 times and a maximum of 14 times. (URL2). Wadsworth, in the 'Architectural Record' journal, fixed these two values for the movie screen at 2 times and 6 times the width of the image (Wadsworth, 1968). According to McVey, the distance depends on the display resolution, and for normal resolution, the minimum viewing distance is 4 times the width of the screen, which can be reduced to 2 times for high resolution. (McVey, 1970). In a study conducted by Ardito and colleagues, they determined the viewing distance for HD resolution to be three times the width of the image and 5.2 times the height (Ardito, Gunetti & Visca, 1996). Narita and his colleagues defined the recommended viewing distance for HD resolution as 2 times the height and 3 times the height (Narita, Kanazawa & Okano, 2001). Sakamoto and four colleagues with women in their fifties found that viewing fatigue was lowest when the viewing distance was between 3 and 4 times the height of the screen (Sakamoto, Aoyama, Asahara, Yamashita & Okada, 2008).

In general, research in recent years has mostly been based on Full HD resolution, and most studies have fixed the viewing distance at 3 times the height of the screen. For 4K resolution, this is approximately half, meaning 1.5 times the height of the display. However, it is advisable to further research this area taking into account the display pixel density, pixel arrangement, and the accommodation and vergence of the eyes. In addition to distance, the placement of monitors is also an important consideration. It is important to note that every 5-degree difference in angle from the screen's centerline can result in up to a 10% loss in visibility. This means that if we sit 45 degrees to the side of the monitor, we can lose 50% or more of the image recognizability and visibility. Similarly, attention should be paid to not placing the screen too high or too low relative to the eye's horizontal line. In the long run, both placements strain the neck muscles (Pheasant, 2003) (Tóth, 2005).

When it comes to monitors, it is preferable to aim for the procurement of industrial-grade display units. Although consumer-grade TVs are more cost-effective to purchase, their warranty typically applies to home use. Industrial monitors come with warranties that extend over several years even with continuous 24/7 usage. Industrial displays have higher brightness levels compared to consumer-grade TVs. While the brightness of TVs intended for consumer and home use is typically around 250 nits[13], industrial monitors range from 350 to 450 nits. The glass surface of consumer TVs is usually glossy, suitable for home use where there are not much light and potential reflection points. Industrial models feature various types of matte and anti-glare coatings to ensure the best readability and visibility. Industrial-grade displays often have a more robust housing compared to household televisions that prioritize aesthetic appearance. This robustness contributes to durability and is crucial for monitor wall installations, offering tighter alignment options.

Camera Placement Maps

Camera placement maps are missing in many places, but they are an important tool for efficient operation, allowing the operators of video surveillance systems to effectively utilize the cameras. The camera map should depict what the operator understands about the real environment. Maps can be paper-based 2D or computer monitor-viewable 2D or 3D versions. The latter better supports the operator in determining the characteristics of terrain objects and other environmental features.

Alerts/Warnings

In a video centre, you may encounter acoustic and visual signals. When designing them, it is advisable to consider the standard 'Management of alarms for the process industries' EN 62682:2015. Audible alerts should be selected at a frequency that is well perceivable amidst background noise without using a volume that could damage hearing. Visual warnings should stand out optically from the background using colour, contrast, or flashing. The use of sound for conveying warning messages can be particularly advantageous in more complex visual environments or when special emphasis needs to be placed on a danger, as sounds generally result in faster reaction times than visual warnings (Wogalter, Conzola & Smith-Jackson, 2002). Audible alerts are generally paired with visual warnings, directing attention to the source of the problem. Audible warnings are advisable for signalling less frequent and more severe dangers. This helps prevent operators from becoming accustomed to frequent alerts and ensures that these signals do not exert psychological pressure.

13 A "nit" is a measurement of the brightness of light. One nit is equal to one candela (one candlepower) per square meter (1cd/m²). It is used to describe the brightness of light sources such as TVs, smartphones, computer monitors, and other displays.

Summary of thoughts

The work of operators involves complex activities that require both material and personal conditions to be met. In our study, we have reviewed the competencies that an operator needs to possess and emphasized the importance of the material infrastructure. We have examined why perception, detection, and attention are crucial in operator work and discussed the challenges in this area. It can be said that an operator must have the appropriate physical condition (well-functioning senses) and be able to receive, encode, and process messages through nonverbal and verbal communication channels. In addition to legal knowledge, societal awareness, and familiarity with characteristics of deviant behaviours may also be expected. We believe that operators belong to a profession that is often overlooked, as they are individuals who work in the background, unseen by society, yet their professional knowledge significantly contributes to maintaining social order.

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