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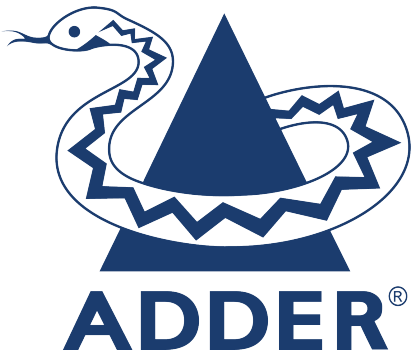
Designing the Control Room of the Future

White Paper



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Foreword

It is difficult to even try and sum up the impact of the COVID-19 pandemic. However, there is a lot that can be learnt from such a globally disruptive event.

This is true of all industry sectors, and across both enterprise and small businesses – digital transformation was accelerated to cope with COVID-19. The instance of the control room (the focus for this whitepaper), was no exception – however, given the mission-critical function such operations play, disruption couldn't so much be minimized as removed entirely.

The term 'mission-critical' is important to define before we go further. There are many types of control room – operating across different sectors. Many have vast quantities of unique needs and requirements in order to function. However, this paper will focus on the core challenges and advancements facing 'typical' mission-critical control rooms, such as air traffic control, emergency services, and transport services control rooms.

The first months of the pandemic highlighted inefficiencies and drove seismic change – and in doing so, acted as a catalyst to long-term change. It accelerated existing digital transformation plans, and shone a light on where these plans were lagging, subsequently bringing an urgency to implementation. These changes need to be reflected in how infrastructure and control rooms are designed. The physical floorplan has given way to virtual footprints, with the onset of social distancing and remote working. Such decentralization has brought myriad benefits and many believe that 'life as usual' will not be returning anytime soon (if ever).

So, what follows is a journey through the command and control landscape, and how designers need to be considering the technology, configuration, and design as we move forward.

This report looks at the lessons learned from the global pandemic, how it enforced a focus on flexibility and adaptability in the control center and, importantly, how the rapid and enforced shift in set-up can underpin the future of control room design.

Foreword cont.

What 2020 and 2021 proved for certain is that designing with a physical-first mentality isn't feasible for future control room planning. To be able to adjust, deliver, and excel, it must go hand-in-hand with the technical and human infrastructure. The priority for operators is the trust in their technology to allow them to do their role to the highest degree; it's not the size of the bezel on their monitor. This paper will explore the backbone to the tectonic change in the control room operation – namely the Internet of Things (IoT) – and how it is underpinning the future of design. It is hard to overstate how important the IoT is going to be to everything we touch in life, especially given how it is powering the move to smart living.

In the control room, it is bringing swathes of data coming from hundreds of thousands of touchpoints across a network. Gathering and parsing this data to provide understandable, actionable insights to mission-critical teams can cut response times immeasurably, through its high bandwidth, near-zero latency, highest-grade security, and utmost reliability. This is a big challenge, but one that technology, particularly KVM (keyboard, video, mouse) solutions, can sit in the center of solving.

KVM affords the ability to process such volumes of data and present it in a manner that is both digestible and shareable, which is bringing untold benefits to those working in the command and control room. High pressure and stress are part and parcel of the job, but must not come at the cost of negative emotional, mental wellbeing to those on the frontline.

As such, the functionality inherent within the technology brings clarity and calmness to the table – which starts a positive feedback loop in terms of positive mental health; faster, more reliable operating teams as well as increased security and uptime. This balance of 'cognitive ergonomics' is pivotal to a best-in-breed control room.

And, naturally, the paper will touch on how KVM can be specified at the center of this revolution and how it is a key enabler in designing for the future of the control room. It is involved at every juncture, as you will see.

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Lessons from Lockdown: The Impact of a Global Pandemic

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If we travelled back to January 2020, no-one could have predicted what lay ahead. The pandemic was emerging as a global threat, but few could have foreseen the unimaginable scale of disruption it would cause; at personal, economic, societal, and political levels. As such, we cannot discuss an industry without considering the spotlight that lockdown shone on where inefficiencies lay and how delayed digital transformation strategies needed to be urgently put in place.

While it needs to be acknowledged that – even as we ease out of restrictions – what was previously 'normal' isn't likely to return like-for-like, it should however be recognized that there is a lot of new behaviors and processes which will improve the way we work.

So what lessons were learned?

We can consider COVID-19 as a catalyst to change; change which will inform the future design, implementation, and management of systems across the command and control sector.

In the control room, the bricks and mortar remained static; it was users and operators who had to adapt – but adapt they did. Decentralization needed to take effect almost immediately, but with zero disruption – something which is simply not an option when you are dealing with mission-critical systems and life-saving scenarios.

The pandemic demanded that control rooms needed to be reconfigured with social distancing restrictions at the core. This included both physical design within the on-site facility including the positioning of people and technical furniture, and an urgent assessment of where staff could operate to their full capacity from a remote position without compromising safety and performance.

Working within a command and control center already demands a prioritized focus on cognitive ergonomics (as we'll discuss later). But the arrival of lockdown measures and social distancing made putting the user first a major transformational challenge, as previously established physical working environments had to be redesigned overnight.

Designing for change

Remote working functionality needs to focus on those outside of the onsite control room. Technical teams must reconfigure systems to not only consider remote connectivity, access, security, and data management but also the ability to visualize data in the same way as if situated within the physical control room.

People have become accustomed to instant and ubiquitous access to data in their personal lives and at home; they expect the same experience professionally and remote working during lockdown showed where systems turned into bottlenecks. While the key operators rarely relocate outside of the control room (it's simply not operationally safe and reliable), we have seen management and non-front line team members move offsite. But always-on access to the right information, and in the right format, remains essential to interpret and analyze scenarios after the event. Equally, management teams don't need to be at the coalface, but still require real-time access at the push of a button, without compromising security.

Without reliable connectivity technology to act as a flexible foundation, the physical redesign of control rooms simply can't be achieved; nor the seamless integration between those in the control room, and those working remotely.

In this regard, the future design of control rooms may have changed forever. There is a necessity for mission-critical systems to adapt to transformative change at scale, supporting the needs of those in the control room and the stakeholders and executives they collaborate with outside.

We can't foresee if such a pandemic may hit again, and life goes back into lockdown. To this effect, the challenge becomes how to design in preparation for unpredictable change – some of which may also be driven by internal shifts – that could quickly change the operation and task at hand. It is here that technology acts as the primary enabler.

From Dials to Data: How Tech has Changed the Control Room

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With its very nature as a hub where mission-critical decisions are made, there are perhaps few industries that have been as revolutionized by technology as the command and control center. These spaces have evolved through being able to integrate every fresh innovation to create a more productive, more agile environment that allows those working within it to make informed decisions which may have life-saving implications. This applies to both the physical aspect of technology, and the infrastructure upon which it sits.

This can be witnessed from three inter-related perspectives. Firstly, the ability to digitally capture data at scale has been driven by the IoT which has subsequently driven the sophistication of systems, such as those concerned with monitoring and data analysis.

Secondly, the ability to parse swathes of structured data has in turn fuelled the growth of machine learning (ML), which has accelerated the process through which an operator's understanding of situations can be analyzed and understood. Importantly, this is impacting both the real-time and the retrospective.

Finally, and most importantly from the end user perspective, the ever-increasing sophistication of interfaces and the ability to share information (and insight), through data visualization and collaboration. Analog dials and monochrome screens have given way to ultra-high-resolution graphics, which has brought clarity in moments of pressure and stress.

Screen real-estate accelerated rapidly, but the number of users and the physical space in the control room remained the same – a situation in part addressed by the rise of video walls and multi-monitor desktops to provide entire teams with the same real-time view of a situation.

It is important to highlight the role that the evolution in telephony has played in the subsequent changes in the control room. Analog messages and telephony have been replaced with Voice-over-IP (VoIP), and Unified Communications (UC), and while the move to VoIP brought a change in behavior and a revolution in terms of scale (and collaboration), the emergence of the IoT will reinvent it further.

So, where does that leave us today?

Despite the rapid growth in data, and enforced changes to working practice, new technologies are removing barriers to optimal operational performance by bringing huge bandwidth, which in turn delivers faster upload and download speeds and near-zero latency. This latter opportunity, for example, means that congested operations will not be subject to throttling (and thus delays) – serious issues when we consider the mission-critical environment.

With operations being fundamentally based on data, the systems that manage how it enters the control room and is subsequently analyzed, interpreted, shared, and acted upon become the most critical facet of how it must be designed.

Breaking paradigms

Until the arrival of high-quality, highly reliable, and secure remote connectivity solutions, the control room had to be based around on-premise infrastructure. Today, the ability to create networks at scale using technologies such as KVM allows the control room to respond to changing industry demands (such as the enforced decentralization of 2020) and the subsequent shift towards remote working.

This has been supported by a rapid acceleration in networking capabilities, faster broadband, and data feeds, as well as mobile-centric data capacities such as 4G (and imminently, widespread 5G), which herald increased bandwidth, highly stable connectivity, and ever decreasing latency. KVM networks can have the added security of disaster recovery and business continuity set-ups, bringing a whole new level of resilience outside the four walls of the control hub. In doing so, technology has reduced (or near eliminated) the risk of wholesale breakdown. Having a breadth of servers outside of a single premise, and giving operators the ability to control and access them remotely, means that downtime due to fault or failure could be immediately mitigated by switching to a back-up operation. This can replicate the set-up of the primary operation, and therefore allow for the whole team to relocate without disruption.

Thinking beyond four walls

The enhancements above demonstrate how, collectively, they have allowed for control room designers to think not just about the space within which to design, but to consider the footprint. Physical constraints do not apply across the board.

Recognition of how the design of workplaces can affect the wellbeing of those working within them, and the ability to perform the task at hand, has come to the fore in recent years – and the control room is no different. However, as opposed to someone within an enterprise perhaps, the pressures of working in mission-critical circumstances puts even more emphasis on optimising the mental health of those within the control room.

In this respect, connectivity solutions, such as KVM, have again driven fundamental change in addressing this need – not least in managing the comparative avalanche of data that operatives are now having to deal with; data which otherwise could rapidly overload a user and cloud judgement. KVM allows operators to manipulate and leverage this mass of data in the way they need to complete the job – allowing them to focus on the task at hand rather than the data and technology at the fingertips.

Screen resolution has had to respond to this seismic shift in data volume to deliver the highest quality data visualization (and subsequent comprehension and action). This clarity is predicated on the detail of the data and the manner in which it is managed; put simply, the quality of the source informs the quality of the output.

This exponential growth of data has been heavily fuelled by the increasing number of connected devices and information points – a factor which will only accelerate with the IoT. However, while not an immediately obvious cause, the explosion of multimedia public-generated content has become a major challenge.

Workflow without KVM =
Causes data overload which makes the operator feel overwhelmed. This often leads to clouded judgement and poor decision-making.

Workflow with KVM =
Creates agile data management and visualization, which leads to better decision-making and outcomes.

The social media influx

Police forces are one of the blue light services which openly invite the public to send in video, pictures, and audio recordings as a means to report problems, issues, and crimes. While not exclusively being used in the control room in real-time, they play a major role in post-event analysis, and are critical to many operators outside of the rapid response team. Having the capacity to share vast amounts of such assets – and therefore data – is crucial.

Where social media has had the biggest impact perhaps is in unfolding events. For example, where the same event is captured or live streamed from multiple angles. Teams in the control room will actively monitor channels to see what videos and images are being shared across major platforms, and then use this insight to react appropriately.

Ignoring this mass of information isn't an option. It needs to be knitted into the real-time data generated by existing control room processes to augment the understanding of an often escalating scenario at hand. The ever-increasing volumes of multimedia data formats have demanded a paradigm shift in the systems and interfaces involved in the control room.

This, in turn, has demanded that the technology frameworks that underpin mission-critical environments have had to rapidly adapt to process such information with near-zero latency, while allowing for seamless, reliable collaboration.

Such a bedrock becomes the catalyst for operators within rapid response teams to calmly share and visualize data to gain a 360 degree understanding of a situation at hand. Without the reliability and security afforded by a KVM network, such a harmonious set-up would be impossible to create.

The Internet of Things (IoT): Game-Changing Technology

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Technology's tectonic shifts have been heavily centered on the explosion of data and its myriad sources. This has brought with it fundamental change throughout how we all live, and through the very fabric of society. Every industry has been impacted – predominantly positively, but not without accompanying challenges in how to manage the groundswell.

The control room is no different, with the emergence of the IoT, and its industrial counterpart, IIoT), adapting rapidly to take advantage of the game-changing opportunities at hand.

This is in part rooted in the management of data within the control room, but it is crucially also reliant on how benefits such as ultra-high bandwidth is freeing up operations outside of it.

But before we discuss how and why command and control centers are building on the IoT opportunity, it is important to understand the technology behind it and the subsequent impact it is bringing.

The networks powering the IoT

It is generally accepted that 2020 saw the advent of 'true' 5G networks. For many, the terminology is rooted in consumer understanding such as the ability to download HD films in a couple of minutes or live stream a sports game on your daily commute. However, it is its application to wider societal and industrial use which is the real game-changer.

The move toward 5G in the control room is a gradual one – such a step-change in speed, low latency, and high bandwidth cannot happen overnight, but it is key to plan ahead and take advantage of the phased approach. This applies to the planning being undertaken by the Systems Integrator as well as the designer of the control room itself.

The impact the IoT has on the control room is huge. If we consider that the speeds brought about by 4G were around 20x faster than the previous 3G networks, and that 5G increases again to around 20x the speed of 4G, near-zero latency becomes a reality.

When this is combined with ultra-high bandwidth, the realization of true IoT networks brings a wealth of emerging data sources together. The effect of this is a surge of data (without network bottlenecks), which in turn massively increases the available insight for those in mission-critical environments, therefore allowing for better, faster, more trusted decision making.

This potential brought about by the combination of exceptionally high speed, fraction-of-a-second latency, and ultra-high bandwidth is augmented by security features with 5G networks. Highly advanced authentication capabilities and trust controls means that the right users can access the right information securely, while intrinsically embedded encryption of data (similar to that used for banking), makes the new 5G networks vastly more secure than predecessors.

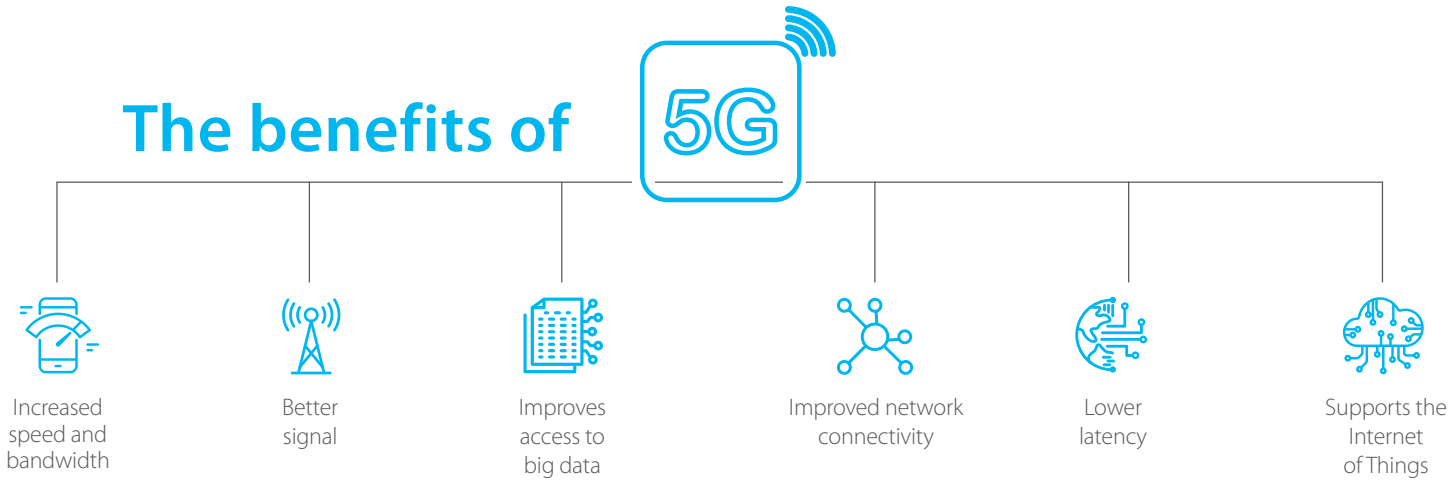

Diagram showing the benefits of 5G.

Case Study: Remote Triage

The blue-light sector inherently handles life-or-death situations. First responders to accident sites must know how to handle whatever lies in front of them, while those in the comms room must remain composed to keep the patient safe and calm.

While predominantly being used to record footage currently, bodycams are already socially accepted and part of the policing armoury. As their capabilities increase and they become part of on-site triage through live streaming, the control room operator will be brought right to the front line. In doing so, however, yet more data will be brought into the mix, adding further demands on the systems involved.

Later, information must then be conveyed to teams within the hospital itself in order for them to prepare whatever is required, all while the patient is in transit to their destination with their situation being critically monitored.

The IoT is already bringing improved efficiencies throughout this operation – and with it, increased survival, and recovery rates. But how could this be taken even further as technology continues to develop?

Those on the front line arriving on-site first are highly skilled medics, but face fresh, unique challenges every day. The overwhelming sense of panic felt by those calling the emergency services often leads to a lack of clear information being shared with the call handler, which in turn makes it difficult for medical staff to prepare appropriately for the emergency they are attending.

5G networks, and the innovations driven by the IoT, will no doubt revolutionize the way blue light control rooms operate. Imagine a bystander at the emergency scene using a smartphone. Using a 5G network, they can now stream real-time video footage of the scene back to the call handler situated in the control room – providing detailed information and insight. Instead of having to describe the situation, teams on the ground, or in the control room, can use this video to communicate with central specialists and get more precise advice. After all, it is easier to see, than it is to imagine.

Once the accident site is under control, then the route to hospital is augmented further through 5G connectivity. Remote, en-route triage allows for the hospital teams to understand what is on its way, and what needs to be prepared, from operating theatre space, medical equipment, and appropriate staff.

Case Study: Driving Insight from 'Digital Twins'

Understanding everything that is going on across a power plant is a daunting prospect. The sheer scale of operations, and the complexity of systems throughout, demands some of the most sophisticated engineers and control room functionality.

Identifying threats, issues, and vulnerabilities before they become a significant problem is essential and is often handled centrally through huge arrays of connected devices. Multimedia assets including video surveillance sit alongside monitors and sensors as core components of a virtual replica of the entire plant site – a model known as a 'digital twin'.

These allow teams to understand the status of every facet of operations and respond accordingly if there are indications that something needs addressing. It can reduce maintenance costs and improve efficiency through pre-emptive action on identified wear and tear.

Critically, it brings untold benefits in safety and operation. But imagine if we could take this one step further and turn the IoT opportunity into one which can protect against widespread, catastrophic outages.

Imagine if you could equip engineers with body cams, and stream real-time footage of the entire power plant back into the control room. No longer are you relying on the interpretation of numerical data to make decisions, but instead using real-time visuals of what is happening across different parts of the operation.

Once captured, this invaluable data can then be visualized in such a way that allows those within the control room to make instantaneous decisions where required, or to share information across teams where necessary. Collaboration and reliability come into their own here, with KVM allowing for the secure communication between the control room operative and engineers working inside the plant itself.

Data, data, data

Digitalization has brought unimaginable exponential growth in data. In 2010, it was estimated that roughly two zettabytes (equal to a billion terrabytes – itself a thousand gigabytes), of data were created, captured, copied, and consumed worldwide. Fast forward to 2020 and the figure is estimated to be nearly 60ZB.†

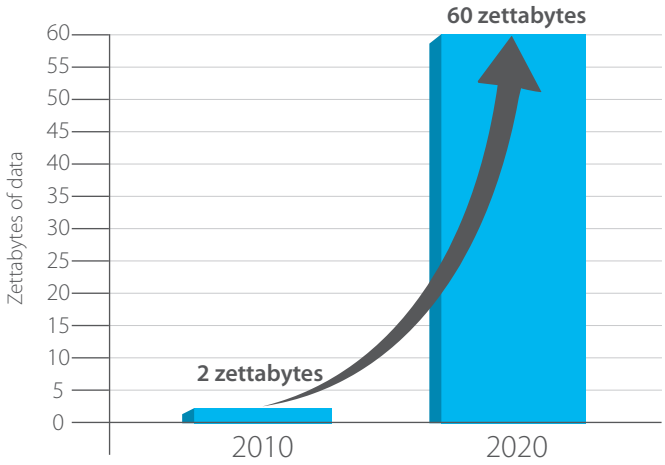

Diagram to show the growth of data worldwide between 2010 and 2020.

This increase in data has been driven heavily by industrial use along with consumer adoption of social media (the latter playing a bigger share, however), and takes the form of both structured and unstructured data. The former type is information that can be tabulated into rows and columns, for example – materials which will come from a database and which are relatively easy to manage, interpret, and analyze.

Unstructured data consists of information which can't be tabulated, and which is not just hugely complicated to make inferences from, but also requires large amounts of storage and bandwidth for real time ingestion. Unstructured forms include text, video, imagery – formats which are becoming ever more prevalent in the functions of mission-critical operations. Furthermore, this data is coming from a wide variety of sources, with an equally wide array of tools and management systems from a patchwork of vendors.

The demands this influx of data brings on the control room are vast – not only on the technology, but also on the operator's capacity to interpret it. KVM systems put the operator at the heart of this information deluge, without compromising the ability to understand and act upon it in the heat of the moment. It gives teams the ability to use them as a unified system.

The flexibility and adaptability of the technology allows operators to unify inputs, reduce navigation and display the data in a more ergonomic and efficient way – through technology such as video walls and shared visualization systems.

This ensures the freedom of collaboration can come to the fore. Crucially, the functionality that KVM delivers in being able to handle the swathes of data while maintaining the highest security protocols, makes it a key factor in designing a modern control room.

While the benefits of structured and unstructured data are clear to see, they can only truly be capitalized on if the technology allows operatives to process the information, analyze it, and act upon it in a logical and timely manner as a team.

†IDC research:
https://www.idc.com/getdoc.jsp?containerId=IDC_P38353

Understanding the value of KVM in an IoT world

As we've discussed, the advent of the IoT – brought about by 5G networks – is bringing an influx of data into mission-critical environments. The insight this brings with it is unprecedented and provides the opportunity for true real-time decision making and collaboration between those within the control room, those more decentralized, and those whose role is predominantly field-based. The real-time aspect of this data should not be underestimated as sheer seconds or minutes in these time-critical scenarios can be vital.

The scale and variation of data sources (due to high bandwidth) – and with them the detail available through which to make decisions – demands an understanding of how data will be consumed across teams both now and in the future. How many users are likely to need access? And to which systems? How will the data be displayed within the control room, and where must instantaneous decision makers be situated to process the data, and respond accordingly? These considerations are key to control room design – not just physically on-premise, but remotely, as the integrated, decentralized model becomes the standard.
IP KVM technology takes these unknowns and the growing quantities of data in its stride. It equips designers with the flexibility to adapt a network depending on the size and needs of the operation. They can easily add and remove end-points when the operation requires it and can offer to change user access rights in a matter of minutes. Importantly, maybe now more so than ever, IP KVM technology can give systems engineers real-time BIOS-level access to remote critical applications with the same performance as a local KVM connection – allowing those working in the field, or away from the control room, to operate as normal.

Understanding how technology can improve the management of the data, and at what pace, and with what detail, must be the foundation to design; the wellbeing of every team member is critical to clear-headed, safe operations. As such, cognitive ergonomics must be considered as critical a function within design as the physical.

Cognitive Ergonomics in the Control Room

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First and foremost, when we talk about ergonomics in control room design, we must accept that the most important factors behind it enable effective decision making – minimizing the risk of human error and operator response time in the process.

To achieve this, we must reconsider the ergonomic paradigm from the physical aspect to the mental aspect, a shift facilitated by prioritization of technology above other elements of control room design. We must consider how both environmental and workplace ergonomics affect the most important of all – cognitive ergonomics.

The definition of cognitive ergonomics, as defined by the International Ergonomics Association, is being ***"concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system".***

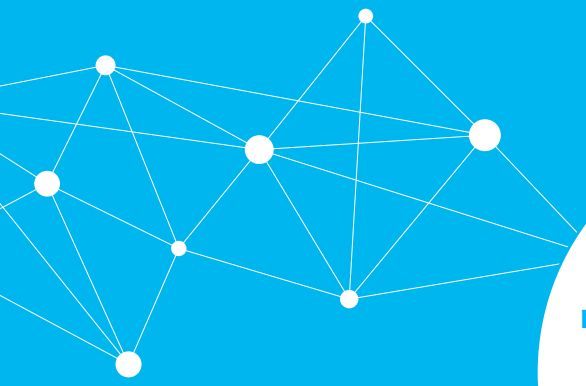
The factors behind cognitive ergonomics make it a highly complex subject. Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design.

Mission-critical clarity of thought

Disruption, interruptions, and information overload can all be factors which impair clarity of thought, and the subsequent wellbeing of those on the front line. This, combined with the rate at which technologies are iteratively improving systems, is intrinsically connected to increasing volumes of data and its subsequent analysis and interpretation – a process we will define as situational awareness.

If the control room operative doesn't have optimum situational awareness, and the mental wellbeing to fulfil their role, then it becomes a threat to the services within which they operate. As a result, managing, reducing, or eradicating factors which impact situational awareness is paramount in order to avoid harmful situations and any impact on mission-critical and potentially life-saving systems.

If we are to give operators the best chance to remain clear headed enough to act under extreme pressure, and make mission-critical decisions, then we must strive to minimize information overload, and aim for superior levels of situational awareness. This end goal must underpin all facets of control room specification and should become an endemic part of the designers brief when planning a new control room space.



According to the Wall Street Journal (2019), US regulators have estimated that as many as 10,000 lives could be saved every year by reducing 911 response times by just one minute.†

†https://www.wsj.com/articles/911-response-times-are-getting-faster-thanks-to-data-integration-11560468747

Avoiding impairment

The next steps to situational awareness are decision, followed by action. As such, the end result can't be accurate (and, crucially, safe), without the right input. The perception of the data coming in needs to be followed by an understanding of what it is telling the user, in order to establish a prediction of future states. This then informs the decision taken and the action to execute it.

None of this can be achieved with mental fogginess. It demands mental (cognitive) energy within working memory – if too much of a user's brain is focused outside of the task at hand, either on the technology or the control room environment, then space within the brain is used erroneously and unnecessarily.

From the operators' point of view, there is an inherent hunger for more data through which to make better decisions. As humans we want to be able to always perform at our best and don't want to be held back by external factors – especially ones which can be resolved.

If data-handling technology is implemented smartly, then cognitive energy increases – but without it, cognitive energy mires in hard-to-manage processes, and hinders decision making. As part of the overall ecosystem, the physical ergonomic aspect of control room design acts as the interface through which this data can be analyzed and acted upon.

KVM technology, which facilitates the control and management of computers and video sources, also goes a long way to improve both physical and cognitive ergonomics in the control room.

Diagram to show the flow to optimise situational awareness

Acting as a collective

The individual demands of every user only tell one side of the story. The ability to work to your best within a team is also a major driver behind success; something which inherently relies on the ability to communicate and collaborate.

While this is true of any business, when we consider the very nature of the control room, where rapid decision making can mean the difference between life and death, this expectancy for collaboration becomes a primary concern. The central operator or supervisor needs to know their control room is functioning as perfectly as possible – something which relies on the immediacy from the supporting team to understand a situation, analyze the option in front of them, and take action accordingly. This relies on working as a team – it can't rest with a single operative.

This collaboration simply isn't possible without the technology delivering it, and with every step-change in technological capability we see a subsequent impact on functionality in the control room.

While KVM is a key enabler behind improved connectivity, collaboration, visualization, reliability, resilience, and security – it can also reduce strain and improve cognitive ergonomics.

Cognitive ergonomics cannot be optimized by making independent and small changes. If control room designers are to positively impact the control room, and minimize the risk of human error, then they must look closely at the workspace and environmental factors affecting operators. For those accessing several different systems from a multiple monitor workstation, KVM technology ensures that the right information is shown on the right screen, at the right time, and that it can be easily controlled with a single keyboard and mouse. This interoperability frees up space on the desk, prevents mistakes and permits a screen layout that is more conducive to situational awareness.

Not only does the layout of the operative's individual workstation impact decision-making in the control room, studies have shown that environmental factors also play a huge part. Control room designers must specify a layout that reduces unnecessary movement, allows for independently controlled temperature and lighting functionality, considers acoustics that make for clear communication, and minimizes operator distractions so they can focus on the task at hand. KVM technology can easily facilitate all these requirements by allowing the repositioning of noisy and heat-generating computers away from the control room, into a secure and purpose-built area. The operator still has real-time access to the data they require but the control room becomes a more comfortable space.

Tackling decision paralysis

Immediacy in sharing and analyzing data, especially that of a sensitive and time-critical nature, allows for urgent decisions to be made. Scenario visualization allows swift, collective decision making between onsite and remote operatives. KVM consolidates systems such as unified collaboration tools and state-of-the-art AV equipment so operators are equipped with the information to make these informed decisions in real-time. These benefits fundamentally support the user being able to perform to their best.

It is paramount that individual control room technologies work together as a solution, so operatives have the confidence that they can instantly access all the applications they need to perform – without delay or technical fault. This interoperability between systems also reduces the cognitive burden that could otherwise be a barrier – a problem which can rapidly lead to increased anxiety, reduced cognitive energy, and a freezing of the ability to come to a conclusion. We call this 'decision paralysis' and in the control room it is simply not an option. It is a cyclical feedback loop which needs to be a positive rather than negative process. Better systems inform better decisions, which deliver better cognitive ergonomics. The same model applies to worse systems, but inevitably results in negative impacts.

2020 as a catalyst for change

The impact that COVID-19 has enforced on how control rooms will be designed is vast. Connected systems will allow those managing the control rooms to make informed decisions around who needs to be in the physical center, and who is able to perform their role remotely. This is not only important to plan for future disruption, but also to prepare for times when the layout of the control room needs to change to adapt to a new operation or crisis.

With social distancing having an impact on the number of people able to operate within the physical space, having the technology which can bring remote workers as close to teams as if they were sat in the same room is key. As such, the consideration in designing a control room needs to move from a 'space' to a 'footprint' – from the physical to the technological. Handled well, the essential cognitive ergonomics that drive success in command and control room will not be disrupted by the fundamental shift in where a team is based, and how they are able to function – both as individuals and as collectives as required.

KVM:
The Vehicle for Change

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User interfaces and user experience

It is important to note that changes and advancements in technology don't just affect the sophistication of the hardware or software. In order for the systems and services to be managed to the highest level possible (thus unleashing the potential power within them), the behavior of the end user needs to undertake seismic change also. The most powerful infrastructure is moot without the users being trained how to use it nor being able to operate it.

As such, the importance of the user interface (UI) and user experience (UX) have never been more critical. To be clear about the difference between the two, we should consider UI as the various data visualizations an operator can see; and the UX being the way they are able to interpret and act upon this information.

KVM networks provide the perfect example of UI and UX in unison and are the cornerstone to which a critical control room functions. The ability to switch instantly between data sources and operating systems means the decision-making process is uninterrupted and the user is able to focus solely on the data and visualizations in front of them; while the collectivization of this information to a single point improves control room ergonomics and brings the real-time collaboration needed between teams.

Should the vast amounts of data be siloed or navigation between them stilted, then the subsequent increase in latency could be the difference between a total blackout in the power plant; misunderstanding of vehicles in transport; or delays in treatment in emergency service scenarios. KVM technology in the control room must be reliable, seamless, and flexible if it is to support operators effectively in these high-pressure environments.

This need must be a core consideration for emerging innovations. At the time, 2002's 'Minority Report' might have seen Tom Cruise using highly futuristic touchscreen technology, but it's now part and parcel of many systems. We can expect this to expand into the control room too once the haptics are completely reliable and sensitive enough to handle visualizations without delay or disruption. In doing so, we can expect to see the emergence of 'KVM-touch' (KVMT) in the operator's toolbox.

Connectivity in the remote-working era

We've already discussed the impact that a global pandemic can have upon working practices, with the dissemination of some of the workforce, fragmentation of teams, and flexible working needing to function alongside fixed, on-premise control room operations. Social distancing has transformed how enterprises behave, and while the control room has a far bigger emphasis for an onsite-based workforce, there will always be an element of remote working that needs to be considered.

It is here where the security aspect of KVM plays a pivotal role in bringing users together; after all, mission-critical operations can't be compromised by widespread teams bringing multiple points of weaknesses into a control room network. Collaboration is key, and the ability to ingest, analyze, and action data as a team remains the highest priority – but not if the payoff is vulnerability.

This must be achieved through a combination of off- and on-site teams where necessary and where distancing prevents the whole team acting in the same room. As such, focusing the design solely around the physical space is ineffective; the networking infrastructure is the backbone upon which everything else must be built.

Importantly, the military-grade security afforded by some KVM systems means that allowing users to access information from a pool of sources is feasible regardless of location. For someone working outside of the physical control room, this not only negates the fact they're remote, but it provides the peace of mind that they are able to perform their role as optimally, global pandemic or not.

A (permanent) break from the norm

The 'norm' as we knew it before various tiered lockdowns is never going to fully return, we can safely bet on that. But this isn't to say it's a bad thing – enforced change has demonstrated that the status quo wasn't perfect and that business, society, and personal lives could be changed for the better. There are myriad lessons that are being learned about how to adapt to the post-pandemic era, with the integration of remote and onsite teams proving a significant one and the ability to adapt quickly seamlessly is another.

It is with this in mind that the flexibility afforded by KVM in repositioning the control room floorplan into a control room footprint comes into its own. Being able to keep the user central to how a command and control center is designed reinforces their ability to perform their role without interruption, delays, data paralysis, and with a positive mental workload.

Workplace decentralization brought about massive change across all sectors. It shone a torch upon lagging digital transformation strategies and put acceleration of such systemic change at the top of the agenda. But this isn't a bad thing – it's brought improved functionality, which will underpin operations in the long-term. Disruption can be seen as a catalyst for positive change, and the role of KVM within the control room is driving this evolution.

Designing a Mission-Critical Future

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The idea of planning for a return to previous ways of operating simply isn't an option. 'Disruption-as-the-norm' needs to be the mindset of every control room designer and systems integrator as they work together to create a future-proof command and control center. And when we say 'future-proof', we are no longer talking in terms of years and a slow migration; we're talking about potential near-immediate shifts in operations, and an infrastructure which can respond to change at short notice.

The technology delivering against these demands is KVM. It is driving the change needed to stay on the front foot, and allowing organizations to respond to a rapidly changing workplace, both in the control room itself, and across the wider network of users.

It could be said that in highly stressful environments, the best technologies are the ones which aren't noticed. The mental pressure of working within a control room demands calmness and focus – both traits are undermined if systems cause bottlenecks, delays in collaboration with team members, or a lack of access to critical information. Frustration isn't an option when it comes to mental clarity in the command and control center.

With the IoT bringing unprecedented volumes of data into the control room, the infrastructure needs to be in place to fulfil the fundamental real-time demands that underpin mission-critical collaboration and connectivity, as life-changing (and saving), decisions are made. Without a KVM solution in place to handle the swathes of data across multiple inputs, the peace of mind necessary to think with a clear head would not be there.

It is this 'peace of mind' which is central to the success of any command and control center, as without it those on the frontline would be overwhelmed. It is hard to think of another environment where the symbiotic nature of technological infrastructure and mental wellbeing of its users is more evident.

The user must always be the utmost priority in control room operations, and that begins in the design itself. However, while this may have been heavily weighted toward a physical footprint, the changes we've enforced since early 2020 are not going to disappear. As a result, the designer needs to think of footprint when looking at creating mission-critical set-ups, rather than floorplan.

The Adder Ingredient

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Control rooms can't be rebuilt every few years, and KVM is a long-term investment. And while on-site installations can be carefully pre-planned to take account of future growth or changes of premises, IP systems can be upgraded at speed and to accommodate rapid change of circumstances.

It is with this in mind that designers need to be radically shaking up how they approach designing a control room that can withstand what is thrown at it today, and what may come tomorrow – with the only constant being 'disruption'. Mission-critical operations demand agility and integration-as-standard to be able to pre-empt changeover and the adoption of new technologies and augmentation of those already in place.

Building for change is very difficult, to say the least. KVM is driving the response to this challenge. It is dealing with the reality of a changing workplace in terms of tens of thousands of new data sources, in terms of physical assets, and millions when you consider the role social media is playing in video, text, and images sent to the blue light sector. It is playing a pivotal role in bringing clarity to the industrial hyper-connected networks across energy and utility plants, where a failure can impact hundreds of thousands of people.

Adder has been designing, innovating, and manufacturing connectivity solutions for over 35 years, and it is difficult to think of a time when the magnitude of the benefits KVM solutions bring has been more evident. This is not just in terms of the response to a pandemic (although the way in which the technology allowed for seamless reorganization has been inspiring), but in terms of what's coming next from a technological standpoint.

With the IoT set to increase the sophistication of mission-critical functions, KVM will become the central hub through which its potential is unleashed, especially when it comes to data. But KVM will also play the key role in making sure those on the frontline remain clearheaded and mentally healthy while performing stressful roles.

The combination of technological advancements with the ever-growing need for IT flexibility will no doubt continue to push IT infrastructures to their limits. But you can be confident that KVM will be the pioneering technology that will see control room industries standing up to the challenge and meeting it head on.

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