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Digital Revolution in Fire Safety: A Pathway to Smarter Protection

A Thought Leadership Whitepaper
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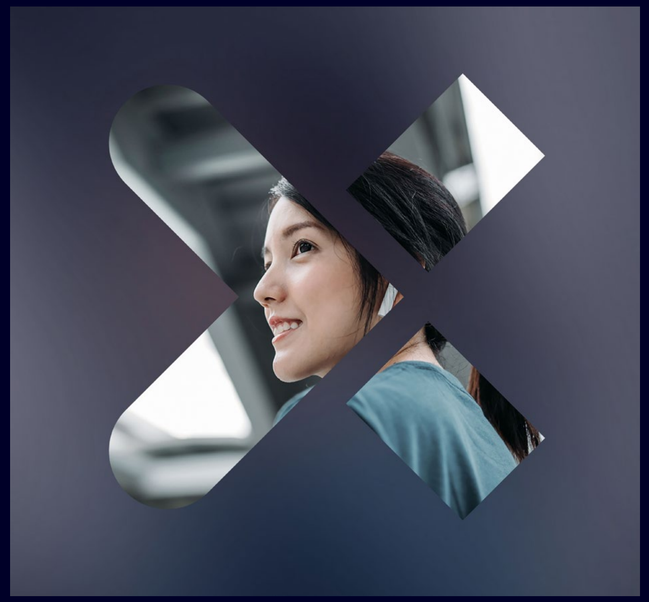

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Fire Safety in the Digital Age

While depending heavily on continuous uptime of (industrial) operations and being highly aware of compliance issues, many companies have not yet decided to go digital when it comes to fire safety. Even though today's challenges are extensive, and the benefits of digital systems are numerous.

A 2022 update of Euralarm's 'False Alarm Study' showed staggering numbers.[1] In Germany, Switzerland, Sweden, and Austria, false alarms made up between 83% and 99% of all fire alarms, leading to evacuations of building occupants, downtime of industry systems, unnecessary deployment of emergency services, and more. These are just some of the shortcomings of traditional fire safety systems.

Other challenges for building operation regarding fire safety encompass a broad spectrum, extending from global trends to local circumstances. Today's buildings need to be energy efficient, resilient to climate change, and, at the same time, safe from strategic or criminal cyber-attacks. On the local level, aging infrastructure must be updated, along with addressing changes in building and fire risks. This implies new and more complex systems in production areas or the introduction of new technologies with other fire safety implications, for example, photovoltaics or electric vehicle (EV) charging. To top it off, all of this must be managed with reduced manpower due to a worldwide labor shortage. Besides all these shared aspects on the building level, there are always unique challenges defined by the business needs and goals of the building's occupants – adding to the complexity.

But solutions are there. Smart buildings with connected systems and sensors allow for real-time status monitoring of their fire safety systems, enabling effective maintenance programs at all levels that increase safety and reduce false alarms. Also, some troubleshooting or planned maintenance measures can be conducted or organized remotely, further reducing disturbances in daily business. Building operators profit from reduced downtime and optimized personnel use and gain sustainability and compliance benefits.

This whitepaper gives a status on today's challenges for fire safety systems and describes the already existing digital solutions, their different levels, and tangible benefits. A look at future trends and tomorrow's buildings completes the paper, all under the motto: Smarter protection.

60% to 70%

of some security guards' time is spent by investigating false alarms.[2]

"Production stops and shutdowns are generally fear factors."

Senior Director
Operations & Processes

"The most important is business continuity. Continuity is the reason we would install it."

Vice President
Production Operations

37 %

of global CO_2 emissions stem from the building sector[2]

85 million

jobs worldwide could go unfilled in the year 2030[3]

The Situation

Global trends and current challenges in building operation

When it comes to building and facility operation, companies face a whole range of challenges. Various global trends have their respective impacts on the operational, economic, or regulatory levels. But also, the specific needs of tenants and their individual businesses must be considered.

Global trends

Not new but persistently present, climate change is the single biggest challenge to modern humanity, with implications for all aspects of life. According to the United Nations Environment Program, the building and construction sector is still, by far, the biggest emitter of greenhouse gases, accounting for 37% of global emissions[3]. Most of the sector's progress is centered around reducing operational carbon emissions that stem from heating, cooling, and lighting. Projections suggest that these emissions will decrease from 75% to 50% of the sector's total emissions in the coming decades.

Another challenge is geopolitical. The war on Ukraine has led to a steep incline in energy costs and inflation in almost all national economies, making energy efficiency an even more pressing issue. On the other hand, hybrid warfare and cyber-attacks have risen from a theoretical threat to a more likely scenario. Whenever attackers of any kind aim at affecting businesses or critical infrastructure, the fire safety systems of buildings or industrial facilities can become possible targets.

The third megatrend in today's (first world) societies is the demographic change leading to growing shortages in the workforce, especially when it comes to skilled labor. An estimated number of more than 85 million jobs worldwide could go unfilled by the year 2030 because there are not enough skilled people to take them[4]. In 2023, the global talent shortage reached a 17-year-high, where 77% of employers reported difficulties in finding talent, with the highest numbers coming from Taiwan (90%), Germany (86%), and Hong Kong (85%)[5].

All these trends, from emissions and energy efficiency to cyber security and labor shortage, form the background for short- and long-term decisions for modern building operators.

Building operation tasks

Based on the Paris Agreement, many national agendas had been set, defining sustainability goals that also have been imposed on the building sector. Now operators need to save resources and lower energy consumption on all levels of the building – not only to reduce CO_2 emissions but also to lower operating costs along with it.

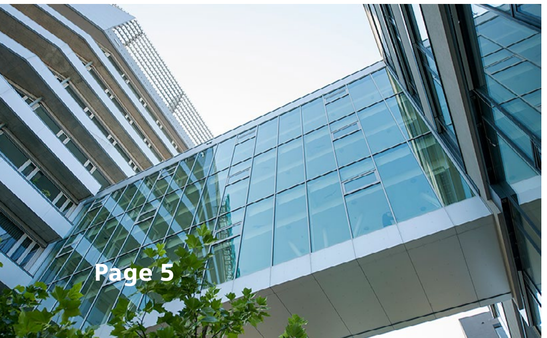
At the same time, safety and compliance are important issues. Buildings must be equipped to match all legal requirements regarding work and environmental safety, which also consists of fire safety regulations on local or national levels. But besides abiding by the law, the highest value within the company is also the safekeeping of personnel, along with the significant role played by materials and infrastructure in all decisions.

This wide range of shared challenges, from global to local, buildings also have individual needs and pain points, depending on their use. Data centers, for example, support critical applications and house valuable data, making downtimes highly cost-intensive for their customers while posing high fire risks due to a high concentration of electrical components. Healthcare facilities like hospitals, on the other hand, rely heavily on business continuity, with interruptions having possible life-threatening consequences. False alarms must also be avoided, as they can lead to difficult and dangerous evacuations. Therefore, fire safety systems must be tailored not only to the building but also to the specific needs of the businesses and users inside.

The Fire Safety Landscape
From risks to false alarms

Taking a deeper look at traditional fire safety systems, operators face a multitude of requirements and challenges on the building level itself – from the technical status quo and its flaws and failures to making the building future-proof and compliant at the same time.

1. Complex systems
Many traditional fire safety systems in today's buildings have been in place for 20 to 30 years, relying on technology with manual processors and maintenance protocols. This has made the work very complex. Adding to the problem is that the workforce who installed and maintained those systems are not available today. And with a new generation of digital natives not experienced or interested in this kind of manual labor, this poses a recruiting problem for companies.



2. Aging infrastructure
A closely related topic is aging infrastructure. Legacy fire safety systems are not the most efficient – and they probably run on outdated technology. So, in cases of maintenance or repairs, sometimes spare parts may no longer be available. Any new system must incorporate updated capabilities and flexibility for future changes.

3. Changing needs in a building
Another aspect of adaptability lies in the significantly higher frequency of change in a building's use. In former times, business spaces remained the same for decades; however, today, the likelihood of change has increased significantly, transitioning from offices to restaurants, and from shops to fitness centers. With the changing business needs also come the requirements for fire safety change. A modern fire safety system should also easily adapt to new user profiles or changing equipment requirements.

4. Interoperability issues
Modern fire safety systems consist not only of smoke detectors and an alarm system, but also sprinklers, emergency lighting, and more. They also communicate with all other systems in the building, from building automation to surveillance systems. For seamless interaction of all components, it is important they share data and signals, making the system more effective and less prone to failure.

5. Compliance requirements
As with all safety topics, also fire safety systems involve a multitude of regulations and requirements that are constantly evolving, making compliance 'a moving target.' Traditional fire safety systems, which also must be checked manually, often fail to adapt to changing requirements. A modern system, on the other hand, allows for remote checks and is open for further technological development.

6. False alarms
The often-spectacular high rate of false alarms of 83 to 99% in some European countries can be attributed to problems with manual maintenance, incorrect function testing, or undiscovered soiling of detectors[6]. These rates need to be lowered to reduce downtime of operations, maintain workflows, reduce stress for people in buildings, and avoid unnecessary deployment of emergency services.

"We constantly have constructions going on, which affect the systems and makes us dependent of the maintenance people."

Director
Business Development

94 to 99%

of all fire alarms in Germany are false[5]

85 to 90%

is the false alarm rate in Sweden[5]

Solar panels and **EV charging**

Evolving fire risks in buildings
In fire safety, there are two important trends in buildings worth looking at: solar panels (mostly on rooftops) and EV parking (typically in underground car parks). With solar panels, statistical data shows that fires are a rather uncommon occurrence, ranging from 0,005% of all installed units in the UK to 1,5% in Australia[7]. Nevertheless, with solar rooftops, fire safety systems include a completely new building level.

Like the safety considerations posed by rooftop structures, a new fire safety concern arises when electric vehicles and their charging stations are located at the underground building level. Their high-density lithium-ion batteries carry the risks of what's known as thermal runaway, a phenomenon that can lead to significant fires or explosions, notoriously challenging to contain. Ongoing research notwithstanding, it's already evident that fire safety systems must address this risk as well. Despite the parking lot or parking garage previously serving as an escape route and fire exit for the building, it has now transformed into a distinct fire hazard that must be considered. This necessitates a reassessment of evacuation procedures and emergency protocols within building design and management.

0,005 %

rate of fire incidents in installed solar panels in the UK[6]

1,5 %

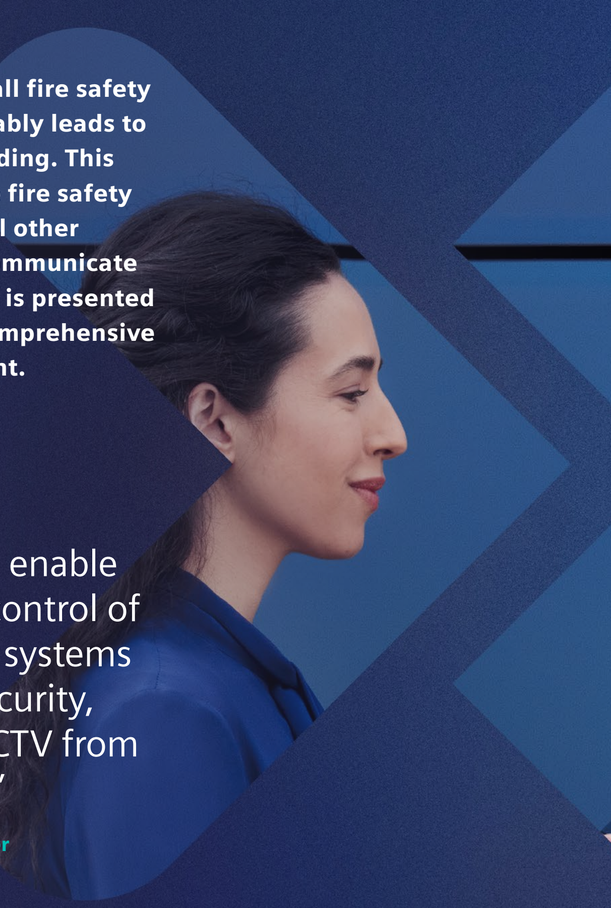
incidents in installed panels in Australia[6]

"False alarms would be a big problem, if we did not have a procedure to verify false alarms. If we evacuated with every alarm, we would be out every day."

Manager
Facilities Services

The Solution
What does it take to be a smart building?

The search for solutions to all fire safety requirements almost inevitably leads to one concept: the smart building. This means a building where the fire safety system is integrated with all other intelligent systems. They communicate seamlessly, and all the data is presented in a single dashboard for comprehensive monitoring and management.



"New digital solutions enable the connection and control of multiple stand-alone systems such as fire safety, security, access control and CCTV from one central location."

Security Manager

Three main aspects of smart buildings

Connect: Intelligent infrastructure
The first aspect of a smart building is the establishment of a reliable and robust network infrastructure. This network allows the seamless connection and integration of various devices and systems within the building, ranging from all kinds of sensors to fire alarm systems, security cameras, access control systems or automation devices. Thanks to Internet of Things (IoT) technologies, all connected devices can communicate and exchange data efficiently. By ensuring integration and interoperability, a unified ecosystem is created, allowing the collection of data from all kinds of sources and thus enabling a holistic view of the building's operations.

Analyze: Cloud-based platform
With the network connection in place, the smart building generates data, which then needs to be put to use. Therefore the second aspect of a smart building comprises advanced analytics and artificial intelligence (AI) algorithms. They play a significant role in processing and analyzing this vast amount of data in real-time. By applying machine learning technology, patterns and anomalies can be identified and potential fire, security or automation issues predicted.

As a powerful instrument, a centralized monitoring and control system alerts building operators, enabling them to make informed decisions about the building's status, performance or maintenance needs.

Act: Services and applications
In the third aspect of a smart building, data-based insights lead to actions. For example the building can automatically adjust and optimize various systems to increase efficiency and comfort, just as lighting or HVAC system operation in response to occupancy patterns or environmental conditions. Also, the integration of fire safety systems with automation and security systems enables coordinated responses to emergencies, with automatic notification of occupants and emergency services, escape route coordination, lighting and more. But also proactive actions become a useful option, when smart buildings generate alerts or notifications to building managers or facility teams about due maintenance or required repairs. Thus, the smart building enhances efficiency, helps to save resources and creates a more comfortable environment.

Data security and sustainability

Besides the imminent advantages in functionality and uptime, a digitalized fire safety system also has some less visible benefits, which are just as important. In today's world, they are dominant topics that customers and regulatory bodies expect companies to address.

Data security
The other important topic for any digitalized service nowadays is data security. Cyber-attacks by criminals or adverse powers are on the rise globally. Therefore, modern, and digitalized fire safety systems come with high-level protection strategies directly on board.

They safeguard security with state-of-the-art measures, typically in the form of an information security management system (ISMS), certified according to the ISO/IEC 27001:2022 standard. This internationally valid norm takes an overall approach to information security by vetting people, policies, and technology.

As the base of any intelligent, cloud-based fire safety system is a secure remote connection for its digital services, an ISO/IEC 27001-certified solution guarantees access only for authorized personnel and reliable connectivity with the appropriate levels of security, protection, and compliance. Even more specifically, it fulfills the requirements for the provision of secure remote services for fire safety systems and security systems, which are defined in the European norm EN 50710:2021. Thus, up-to-date digital fire safety systems tackle all cyber-security challenges while offering numerous benefits for building users and their individual business needs.

Sustainability
Adhering to ESG practices (Environmental, Social, and Governance) has become more than a statement of responsibility for today's companies – it is a necessity now. Societies and governments expect it, and reporting on it will be required, for example, by the Corporate Sustainability Reporting Directive (CSRD) of the European Commission as of 2024.

Here, digitalized fire safety systems can make a notable contribution, as they have several impact angles on sustainability. Thanks to their remote diagnostics or troubleshooting functionalities, on-site visits by external technicians can be reduced significantly, and, if needed, technicians come better prepared and with all necessary spare parts. Thus, the number of trips and CO_2 emissions are reduced. Another aspect is saving water. Modern sprinkler systems are equipped with sensors that not only monitor 'regular' water usage but also detect leakages or irregularities in the system, leading to less resource water waste.

The construction of components offers further sustainable benefits – from more environment-friendly materials in smoke detectors to a more general principle of constructing all systems with forward and backward compatibility. Thus, new equipment can be seamlessly integrated with existing systems, eliminating the need to exchange more parts than necessary, and keeping the whole system scalable and adaptable for all future changes.

Secure connectivity
To connect fully and to allow real-time monitoring and remote access, a smart building has a secure internet connection. Modern cloud-based solutions provide flexibility, reliability, and security, opening all options for fast decision-making and full control over all building functions and processes.

Building information modeling (BIM)
The digital method for construction and operation

When it comes to digitalization in the building sector, there is no way around BIM. Building information modeling is a digital method for planning and operating buildings, which allows all involved parties to work with one shared virtual model of the building – from architects to HVAC engineers to fire safety planners. Every pipe, every power outlet, and every sensor are located and documented in the model, which not only makes construction and installation easier but also helps to improve maintenance. BIM can even generate a digital twin of the completed building that allows monitoring all data in operation and optimizing efficiency.

"It is difficult to test and maintain systems in buildings with running operations."

Deputy Director
Security, Safety, and Facilities Operations Management

Fire safety in a smart building: **The advantages**

Smart building integration with fire safety systems means, for example, that data is shared with other building systems, such as sprinklers, elevators, or smoke control. Furthermore, by accessing data from other building systems, the risk of false alarms can be reduced. In real cases of fire, this data can verify the source and location of the fire. Also, by connecting fire safety systems with emergency communication systems, building users and firefighters can get clear and consistent information and instructions, such as fire status and location, safest exit routes, or availability of elevators. Remote and efficient monitoring and troubleshooting of fire safety systems are also feasible.

The **Journey**

From reactive to prescriptive maintenance

One essential aspect of fire safety is maintenance. With detector soiling being one of the most common reasons for false alarms, a regular check of the sensors is an obligatory prevention measure. But also, adjustment of detectors to changes in room use or geometry or precise documentation of alarms (real and false) can be helpful. In a smart building environment, the maintenance of fire safety systems is taken to a new level – with an evolution of possible services from reactive to prescriptive.

Onsite Reactive
Also known as ‘corrective maintenance’, this is the base of maintenance measures. It is unplanned and carried out on-site, as it just reacts to occurring failures. When an event happens, a technician is deployed and repairs it. Should personnel shortages, simultaneous events, or technical difficulties come into play, this can result in significant downtime.

Remote Reactive
Based on established connectivity, experts can monitor building data at any time from any place, and conduct fast remote diagnosis. In some cases, the problem will even be solved remotely, in others its precise identification enables dispatching the right staff with the right equipment.

Proactive/Preventive
On this level, the number of digital touch points is increased, enabling added fault detection and diagnostics functions. Thanks to this, on-site monitoring can identify issues before they become a problem. Also components can be maintained or replaced at the optimal time with all equipment or spare parts at hand, which leads to shorter outage of the system.

Predictive
By adding Artificial intelligence to the concept, a digital-eye, 24/7 continuous monitoring performance is established. Data is collected, correlated, and analyzed using models and machine learning algorithms to predict which specific services will be needed, and when.

Prescriptive
The last step of the way is completed by adding application programming interfaces (APIs). Thus, correlating and analyzing of data extends beyond the single building level and allows seamless workflow integration. Users receive information from all systems and services that interface with each other, providing a complete picture of system performance and enabling automated root cause analysis.

Dashboard, app, and remote supervision
Modern fire safety system tools
Thanks to connectivity and integration, smart building operators have helpful tools available, which improve their access to information and enhance usability. Modern fire safety systems can visualize systems and provide relevant information in real-time on a dashboard. Users get an overview of different locations and can also generate reports for auditing or share files. And through mobile portals or apps, they can access all information anywhere and anytime. Another useful function is remote supervision, which can be conducted by an external service provider. Thus, users benefit from experienced troubleshooting support, intervention preparation help, and improved system performance.

“I want to connect to the status of the system, no matter where I am.”

Assistant VP
Facilities Services

The Benefits
What's in it for building operators?

By implementing a digitalized fire safety system, building operators can go way beyond compliance. More than that, they utilize the power of smart buildings for the safety of people, assets, and spaces. It is a future-oriented solution flexible and open to change – and features a whole variety of benefits.

Quicker reaction to incidents
Integrated sensors enable real-time monitoring of detectors and give precise system status information. Building managers can remotely supervise – even on mobile devices – and decide quickly about adequate measures.

Reduced disturbance of operations
Predictive analytics enables maintenance before problems occur, significantly reducing false alarms or component failure. Reduced production process interruptions and fewer occupant evacuations are among the results.

Reduced downtime
With remote management capabilities, planned maintenance downtime can also be reduced drastically. Disturbance-free detector tests make manual tests obsolete, but also better timing of maintenance and fewer and shorter maintenance processes have an effect.

Improved cost-effectiveness
As a result, building operators optimize their outcomes thanks to more productive uptime and fewer business interruptions due to false alarms or necessary repairs. Also, condition-based maintenance enables the optimum use of resources, with components replaced at the perfect time in their lifecycle.

Optimized use of personnel resources
Digitalized fire safety systems transform manual workflows with digital ones, efficiently combining remote operator support for troubleshooting with a reduced workload for on-site technicians.

1st benefit of fire safety systems was 'safest place for people and assets' in a business survey[8]

2nd benefit In the same survey was 'compliance'

The Future
Tomorrow’s buildings and their digital fire safety

Artificial intelligence and machine learning are on the rise in practically every aspect of technology – and fire safety is no exception. Together with digitalization, they could contribute massively to further improvement in the near- and medium-term future.

Multi-sensors
Multi-criteria detectors combine smoke, heat, and carbon monoxide sensors to improve overall detection accuracy and reduce false alarms. Advanced sensors can even detect changes in air quality, temperature, and humidity to provide a comprehensive understanding of the fire risk.

Machine learning and computer vision
Advanced sensor data can be used by machine learning algorithms that process vast amounts of data and compare them to historical fire incidents. They can identify trends, risk hotspots, and individual hazards. As a result, this predictive capability enables proactive planning and resource distribution.

Machine learning also takes video detection to another level. Smoke detection cameras learn to recognize the visual signature of smoke, enabling early and accurate detection in indoor and outdoor situations. Also, scientists are working on mobile, smartphone-based applications that feature real-time detection of fire-related activities on construction sites. They use deep learning solutions to classify scenes, detect and track objects, and then analyze fire-related activities from video images in real time.

Artificial intelligence
AI-powered fire safety systems can also optimize the performance of fire suppression systems, such as sprinklers or suppression agents, by dynamically adjusting their operation based on real-time data. The algorithm can determine the ideal distribution of water or fire-retardant chemicals, which ensures maximum effectiveness and minimal waste.

Automation and robotics
In connected environments, also automated responses are possible, for example, closing fire-rated doors, initiating HVAC shutdowns, and activating emergency lighting or dynamic and voice-guided evacuation. Even firefighting robots are already at work; equipped with sensors and suppression systems to assist in conditions unbearable for humans. For now, they act remote-controlled, but partially or fully autonomous systems are only a matter of time.

> “Going digital is the only way to survive, also because of the lack of hands and knowledge.”
>
> **CEO and Company Owner**

Conclusion
Join the (Digital) Revolution to modernize your fire safety system!
Today, fire safety systems going digital is an option. But tomorrow, it will be the norm. And already, the benefits are convincing. Installing a comprehensive digital fire safety system will allow building operators to manage their buildings in a cyber-secure way and, at the same time, contribute to their sustainability goals.

Choosing a system that can evolve and adapt over time to the changing building and business needs is an intelligent investment for the future. Going beyond compliance – a digitalized fire safety system will protect people, assets, and spaces alike.

Further Information

Do you want to learn more about the digitalization of fire safety systems and its benefits for your company?

Please contact us, we are happy to assist you.

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Global Headquarters
Theilerstrasse 1a
6300 Zug
Switzerland

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3617 Parkway Lane
Peachtree Corners, GA
30092
United States

For more information, please contact
Tel +41 41 724 24 24

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References

1 Festag, S. False Alarm Study: Increase Fire safety by Understanding False Alarms, 2nd Ed., 2022

2 Verdantix Study: Modernizations and digital transformation, 2018

3 https://www.unep.org/resources/report/building-materials-and-climate-constructing-new-future

4 https://www.kornferry.com/insights/briefings-magazine/issue-30/2030-the-very-human-future-of-work

5 https://go.manpowergroup.com/hubfs/MPG_TS_2023_Infographic_FINAL.pdf

6 Festag, S. False Alarm Study: Increase Fire safety by Understanding False Alarms, 2nd Ed., 2022

7 https://core.verisk.com/Insights/Emerging-Issues/Articles/2023/October/Week-4/Are-Solar-Panels-an-Emerging-Fire-Risk

8 Kunde & Co, FS20i Interview Results, April 2022

9 https://ieeexplore.ieee.org/abstract/document/9987855