SIEMENS

STORIES OF HONG KONG

Transform the everyday to create a better tomorrow

Dear reader,

With the COVID-19 pandemic as the biggest health, social and economic crisis in this decade, the recent years have made a huge impact on the business environment of Hong Kong as well as the global world. To embark on a journey of creating a better tomorrow, the pandemic creates a critical opportunity for us to combine economic growth and ease the pressure on our environment.

At Siemens, we are serious about our responsibility to our employees, to our partners, and to the society; therefore, sustainability has long become an integral part of our businesses. Taking our ESG commitment to the next level, Siemens has established DEGREE framework that enables us to deploy the right technologies nicely and integrate environmental consideration into our portfolio that tackles the unique pain points of cities. To achieve this, we leverage the convergence of digitalization and sustainability to empower Hong Kong to drive sustainable and high-value growth across energy management, buildings, industry and mobility sectors.

This book is all about stories in Hong Kong and further clarifies the values that you can capture along the digital journey. We will illustrate how we build smart infrastructures to significantly enhance performance and deliver the best possible user experience. Stepping up our efforts, we utilize new technologies like AI, IoT and digital twin to optimize data center operations, embrace re-industrialization as well as transforming building lifecycle management.

I wish you will have an interesting read and I look forward to collaborating with each of you to transform our everyday.

Erdal Elver
President and Chief Executive Officer
Siemens Hong Kong and Macao

Content

Accelerate! Merging real and virtual worlds

From a German industrial giant to a global technology company, Siemens has been driving digital transformation to successfully address the challenges arising from megatrends such as climate change and glocalization. Creating purposeful technology that adds real value to customers not only made Siemens a digital thought leader but also provided the blueprint for Hong Kong to become a smarter and more sustainable city.

The COVID-19 pandemic has changed every business almost overnight. Added to this are climate change, growing glocalization, and the urgent need to further promote sustainability. As such, Hong Kong's future growth will be shaped by its ability to maximize efficiency while prompting businesses to adapt to the evolving environment. Erdal Elver, President and Chief Executive Officer of Siemens Hong Kong and Macao, believes that these challenges can be addressed and mitigated through digital transformation.

Merging the physical and virtual worlds

"True digital transformation is the elimination of the barrier between the physical and digital worlds. This process helps businesses better understand and use their data as well as changing their processes and business models to make things in a more optimized way." Erdal explains, pointing out that companies that leverage data can unlock infinite opportunities and make better and well-informed decisions. "Data is now imperative for companies to ensure business continuity and establish a competitive advantage."

"Think big and start small" to build a co-creation ecosystem

"We started our digital journey several years ago. From building a digitalization team to fostering a digital culture to setting up a digital hub that collaborates with Hong Kong's infrastructure providers, today we are unlocking the real value of digitalization with our customers across energy, buildings, industry, and mobility

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>
> **Erdal Elver**
> President and Chief Executive Officer,
> Siemens Hong Kong and Macao

> Empowering our customers through co-creation, Siemens Xcelerator makes digital transformation easy, fast, and at scale.

Erdal Elver
President and Chief Executive Officer,
Siemens Hong Kong and Macao

sectors," says Erdal, illustrating the achievements that followed successful proofs-of-concept, such as Smart Offices, digital substations, renewable lighting systems, smart facilities management systems, and so on. The goal of a series of open-innovation initiatives is to empower people to think big and start small. "Through the process of innovation, we create an open environment for cities to churn out innovations faster and build an ecosystem that closely connects the government, technology partners, businesses, and startups in Hong Kong."

Siemens Xcelerator – easy, fast, and at scale

"At Siemens, we not only plant the seed of innovation within our people but also create fertile soil for the seed to grow and thrive. Empowering our customers through co-creation, Siemens Xcelerator makes digital transformation easy, fast, and at scale," says Erdal, who explains that Siemens Xcelerator is an open digital business platform comprising a curated portfolio of products, solutions and services, software, and IoT connectable hardware. Representing an ecosystem of more than 4,000 partners, Siemens Xcelerator forms a marketplace that enables users to explore, engage, and exchange. Coupled with its open architecture, the platform allows users to easily configure and customize applications to their own needs and find all of Siemens' and their partners' digital offerings in one place. "With Siemens Xcelerator, we further break down silos and combine traditionally segregated businesses, technologies, and processes. This enables us to create state-of-the-art solutions that can be easily scaled. But more importantly, all stakeholders can interact, build, share and transact, amplifying value through an ecosystem of collaboration that helps drive innovation.

Xcelerator, an open digital business platform, comprises a portfolio of products, solutions, services, software, and IoT connectable hardware.

Erdal gives an example of how Siemens Xcelerator can help customers meet their sustainability goals. "Companies need reliable and verifiable data to track the CO_2 footprint of each of their products. SiGREEN, Siemens' software for managing emissions, preserves the data sovereignty of all participants in the supply chain." Erdal further explains that value can be created when different business offerings are combined in the software on Siemens Xcelerator. "Trustworthiness is secured using cryptographic keys in peer-to-peer communications, enabling companies to identify potential for improvement efficiently and securely, and reduce emissions faster." By offering a digital space equipped with a searchable portfolio of products and solutions, Siemens Xcelerator creates a virtual realm where manufacturers, suppliers, and solution providers form mutually beneficial relationships, working together to develop efficient ways to meet the challenges of achieving net zero.

Erdal Elver has spent the last 38 years working in Germany, Vietnam, China, Taiwan, as well as Hong Kong. In early 2021, he became the President & CEO of Siemens Hong Kong and Macao. Ever since, he has been driving the strategy focusing on digitalization and sustainability and creating an ecosystem that closely connects Hong Kong's stakeholders.

> We should never take Hong Kong's current competitiveness for granted. Hong Kong must persist with innovation and create technology with purpose.

Erdal Elver
President and Chief Executive Officer, Siemens Hong Kong and Macao

A living lab piloting proofs-of-concept

According to Erdal, Hong Kong, as one of the world's densest cities, is facing the same urban challenges that many cities in the GBA are encountering, such as aging infrastructure, rising energy complexity, traffic congestion, and extreme weather conditions. As such, Hong Kong is an ideal "living lab" for piloting proofs-of-concept that demonstrate the value of innovations. The GBA presents a unique opportunity for such concepts to be eventually scaled up for everyone's benefit and for companies in the region to tap into international networks. Apart from being adjacent to other cities in the GBA, Hong Kong possesses many other strengths when it comes to doing business. For technology companies like Siemens, a sound legal system and strong IP rights protection build trust for innovation development before idea adoption.

Creating technology with purpose

Despite the number of strengths as mentioned, Erdal reinforces that Hong Kong's competitiveness still depends on its dynamism, its ability to evolve and change under growing competition, and the increasing complexity of market demands across Asian countries. "We should never take Hong Kong's current competitiveness for granted. Hong Kong must persist with innovation and create technology with purpose," concludes Erdal.

With great power comes great **sustainability**

Creating technologies for smart infrastructure

Much like many other cities around the world, Hong Kong is at a crossroads where we must effectively navigate the urban challenges ahead. This is precisely why Siemens is constantly striving to empower customers on their digitalization journey. In connecting the value chain across energy systems and buildings for greater efficiency and sustainability, Humphrey Ling and Ricky Liu from Siemens Hong Kong and Macao shares their stories on how to create technologies that enable smart infrastructure to enhance the way people live and work.

Humphrey Ling
Vice President,
Siemens Limited
Hong Kong and
General Manager,
Smart Infrastructure

Having led a fruitful career spanning over 30 years in Siemens, it is not an exaggeration to call Humphrey Ling, Vice President, Siemens Limited Hong Kong and General Manager, Smart Infrastructure, a veteran in the technology field. When asked for his recipe for success, Humphrey highlights the importance of prioritizing customers and their needs. "By adopting a customer-first culture, we have cultivated long-standing relationships with our customers, and our solutions ensuring a high level of power reliability is a testament to Siemens' reputation as a trusted and reliable partner," Humphrey says. "As one of our core priorities, we commit ourselves to drive customer impact through anticipating what our customers need before they even know it themselves."

With an extensive background in the building sector, Ricky Liu, Vice President, Smart Infrastructure Regional Solutions & Services Middle East / Asia-Pacific, has not only witnessed the evolution of the building landscape from automation to digitalization, but also served as a trailblazer in facilitating this transformative change. In his perspective, smart infrastructure is the key to fostering sustainable urban development, with digitalization acting as the bridge to streamline this transition. "Smart infrastructure is sustainable infrastructure," says Ricky. "Sustainable infrastructure can be interpreted in two ways: future-proof infrastructure that is both resilient and adaptable in the face of future challenges, and that aligns with our decarbonization goals to minimize environmental impacts imposed on our planet; digitalization is an indispensable part of this equation."

Ricky Liu
Vice President,
Smart Infrastructure Regional Solutions &
Services Middle East / Asia-Pacific

Empowering customers and the society through hard times

Over the years, Siemens has garnered hard-earned trust from customers by consistently providing support to them as well as the society as a whole, especially in times of crisis. In a recent example, Siemens stepped up to the challenge and bolstered its support to the community in combating the fifth pandemic wave through energizing quarantine camps built for the isolation and treatment of COVID-19 patients in

Smart infrastructure is sustainable infrastructure.

Ricky Liu
Vice President. Smart Infrastructure,
Regional Solutions & Services Middle East / Asia-Pacific

record time. “Our colleagues worked round-the-clock to ensure package substations were delivered to the site on time to provide reliable energy supply for the quarantine camp. While these projects generally take around a month to be executed, owing to the severity and time-sensitivity of the project, we were able to bring it to completion within 72 hours,” Humphrey explains.

This was not the only instance in which Siemens empowered their customers through difficult times. Back in 2020 during the early days of the pandemic, Siemens was reached out by their customer to transform six normal wards into isolation wards. Despite that there was no prior maintenance contract in place, taking into account the urgency of the circumstance, Siemens regarded it as an exceptional case and commenced with the project right away. “Within the short span of a single day, we managed to set up the pressurized system for the isolation wards so that the hospital could accommodate the influx of COVID-19 patients and ensure that they receive the treatment they need,” Ricky recalls. “I’m proud that Siemens was the first company that came to mind for our customer when they were in need.”

Shaping the future with digitalization

As the trend of digital transformation gains traction, endless possibilities are generated within the smart infrastructure ecosystem. For one, the energy systems of the future are becoming increasingly decarbonized, distributed, and digitalized. How does digitalization come into play within the context of the energy sector? “With this fundamental transformation in full swing, digitalization plays a significant role in enabling us to master the changes that arise and shape the future of the energy landscape,” Humphrey points out. Using digital substations as an example, he illustrates how digitalization lends itself to bringing key benefits to the entire grid: “As an integral component of power grids, substations lie at the heart of the power supply – that’s why digitizing substations brings us a step closer to successfully shaping the transformation of energy systems. With our digital substation solutions, point-to-point copper cables from traditional substations are replaced with fiber optic communication systems, allowing digital substations to be operated in a much more cost-effective way over their lifecycles. This brings a number of benefits which include lowered installation costs, better measurement accuracy to monitor, control, and protect valuable assets, as well as streamlined lifecycle management.”

Ricky highlights the solutions to decarbonize buildings which account for 60% of Hong Kong's carbon emission.

Humphrey illustrates how digitalization plays a significant role in shaping the future of the energy landscape and bringing value to the entire grid.

We commit ourselves to driving customer impact through anticipating what our customers need before they even know it themselves.

Humphrey Ling
Vice President, Siemens Limited Hong Kong and
General Manager, Smart Infrastructure

In this age of hyperconnectivity, data is essential for businesses, and data centers are the backbone of our society and industries. Stemming from the rapid technological advancement, demands for data usage has been increasing at an unprecedented rate. How can we meet current demands while planning for future capacity? “Cooling accounts for the largest part of electrical energy consumption in data centers after IT. To tackle this challenge, Siemens’ White Space Cooling Optimization solution links up IoT sensors with AI and cooling unit controls to determine the ideal temperature at the rack-level and deliver dynamic cooling management. This enables increased thermal reliability, optimized equipment maintenance, and reduced operational costs, allowing customers to ensure continuous and

efficient operations of their data centers. “In just five years, 14 new data centers will be built to cater to the rising demand for virtual connections. It is exciting to see how digitalization can help solve the toughest challenge in the market.”

Balancing sustainable development with progress

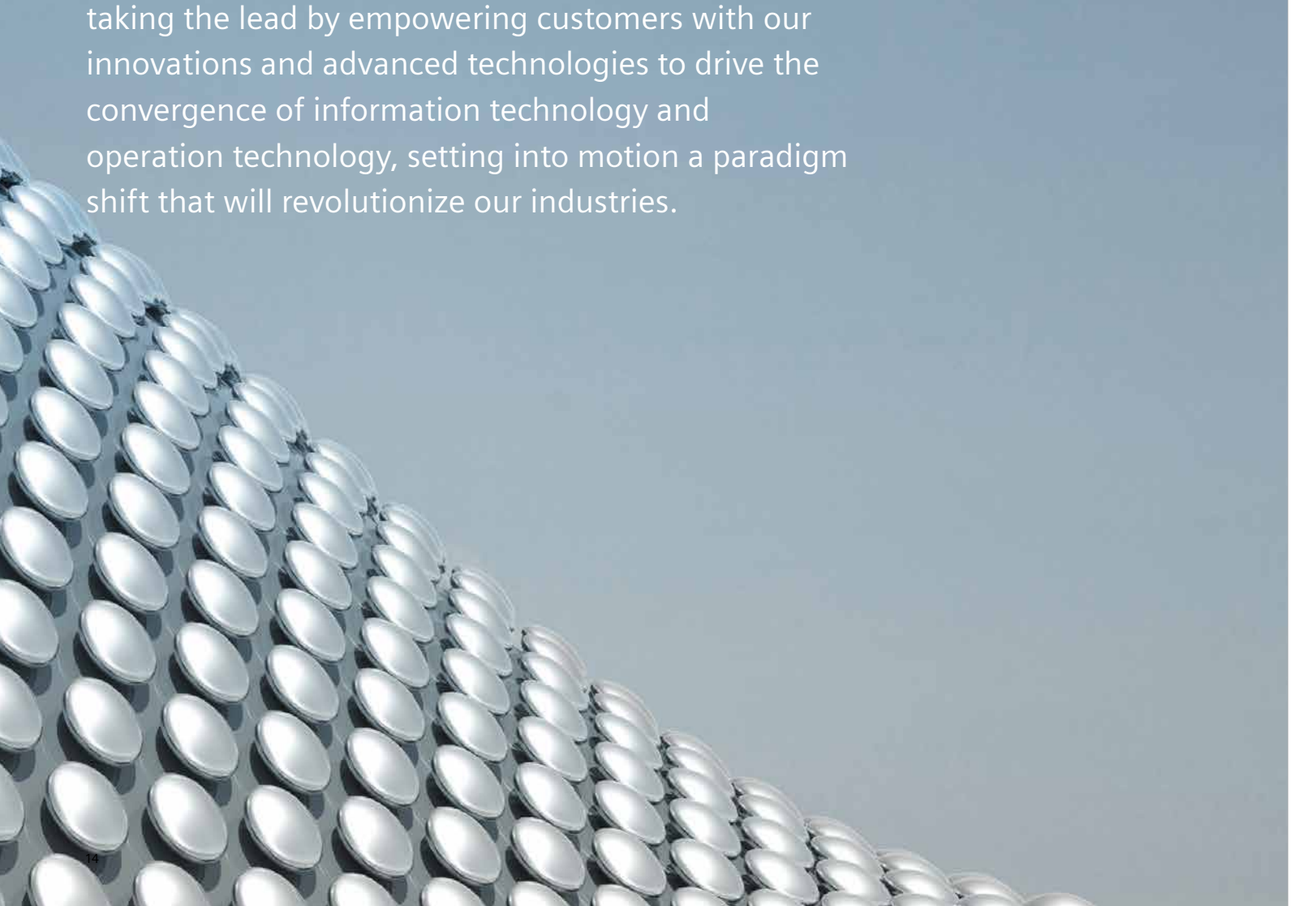
Apart from pushing for technological progress, the immense potential of digitalization can also be leveraged in smart infrastructure to generate lasting values for our planet. Accounting for 90 percent of electricity used in Hong Kong, buildings generate over 60 percent of Hong Kong’s carbon emissions. “It is precisely because of this phenomenon that we must set our priorities to decarbonize our buildings,” Ricky points out. “This gives rise to lots of opportunities where we can reduce our carbon footprint and achieve significant results.” With the power of IoT and workplace intelligence platforms, Siemens’ expertise in smart building solutions is paving the way for a carbon-free future. In particular, their smart office offerings feature smart lighting solutions to promote energy efficiency as well as tenant comfort. Powered by Siemens Enlighted and Comfy, their award-winning IoT technology is leveraged to facilitate optimized office space usage and ensure energy efficiency, creating safer and smarter workplaces.

On the other hand, Siemens is similarly devoted to decarbonizing mobility by working to expand e-mobility coverage in Hong Kong. Along with the rise in electric vehicles (EVs), efficient and reliable e-mobility infrastructure is needed to support the widespread implementation of EV usage. In decarbonizing transportation, Siemens’ fast e-bus charging infrastructure employs opportunity charging, which enables fast charging without any carbon emissions, proving itself to be easily integrated with public transportation vehicles such as minibuses. Going into more detail, Humphrey illustrates why this technology is suited to be carried out in Hong Kong: “Hong Kong's minibuses operate in stop-and-go traffic while most of their routes are rather short. Through our automatic “Off-board Top-down-Pantograph” charging technology, depot-less minibusses can now be charged in frequent and regular intervals between stops. As a result, less battery capacity and charging time is required, which facilitates a more sustainable way to energize electric minibuses and accelerates our progress in realizing our decarbonization goals.”

Innovative technology has always been at the core of Siemens, and it remains at the core of the future that is actively being built right now. Powered by the determination to empower customers on their digitalization and sustainability journey, Siemens is providing the best-in-class Smart Infrastructure solutions that brings the possibilities of tomorrow to our customers today.

Gearing up for Hong Kong's **industrial (r)evolution**

From the groundbreaking invention of the steam engine to the proliferation of digital technologies, the world has undergone four industrial revolutions over the years, and Siemens has shaped each and every one of them to improve the lives of many. With the introduction of Industry 4.0, Siemens is once again taking the lead by empowering customers with our innovations and advanced technologies to drive the convergence of information technology and operation technology, setting into motion a paradigm shift that will revolutionize our industries.



With a wealth of industry knowledge acquired from his time in China, Jason is an exemplar of young talents in Siemens and became Head of Digital Industries in 2020. Ever since, he has been channeling his expertise in driving digital transformation within the industrial field in Hong Kong.

All set for Industry 4.0

The re-industrialization initiative was introduced by the Hong Kong Government aiming to revitalize our industries and promote a more diversified economy. "Given Hong Kong's limitations in land and labor resources, our industrial landscape has since shifted away from mass production – the focus in this newest phase of industrial revolution should instead be placed on high value-added and high-end manufacturing industries based on new technologies and smart production, for example, pharmaceuticals, food and beverages, electronics, and robotics, amongst other emerging industrial sectors," says Jason Kuang, Head of Digital Industries in Siemens Hong Kong.

Unleashing the full potential of data with cutting-edge technologies

In this day and age, industries are expected to optimize and streamline production processes so as to anticipate demand, enable product customization, and remain resilient and agile in the face of unforeseen obstacles. With infinite data generated from IoT, infinite opportunities are there for the taking; this is where Siemens comes in. Having transitioned from an industrial giant to a focused technology company, Siemens' industrial DNA coupled with strong IoT expertise are at the core of its unmatched ability to shape the future of re-industrialization.

"By integrating cutting-edge technologies like Artificial Intelligence (AI) and IoT with big data, we empower our customers to exploit the limitless potential of data and navigate both current and future challenges," Jason says. "Large amounts of data can now be analyzed in real-time and leveraged to generate valuable insights: through digital twin and predictive maintenance, production processes can now be optimized with reduced costs and unplanned downtime – all of this leads to more efficient and sustainable industrial processes."

Driving digital transformation throughout the entire value chain with IoT

"While many factories are already automated, there is still a considerable gap until digitalization can be achieved throughout the entire value chain." Jason points out. In light of this, it becomes especially important for factories to employ a one-stop-shop platform that provides

> As an innovation leader set on transforming our industries, digitalization and automation as game changers will enable us to meet such challenges on the way to Industry 4.0.

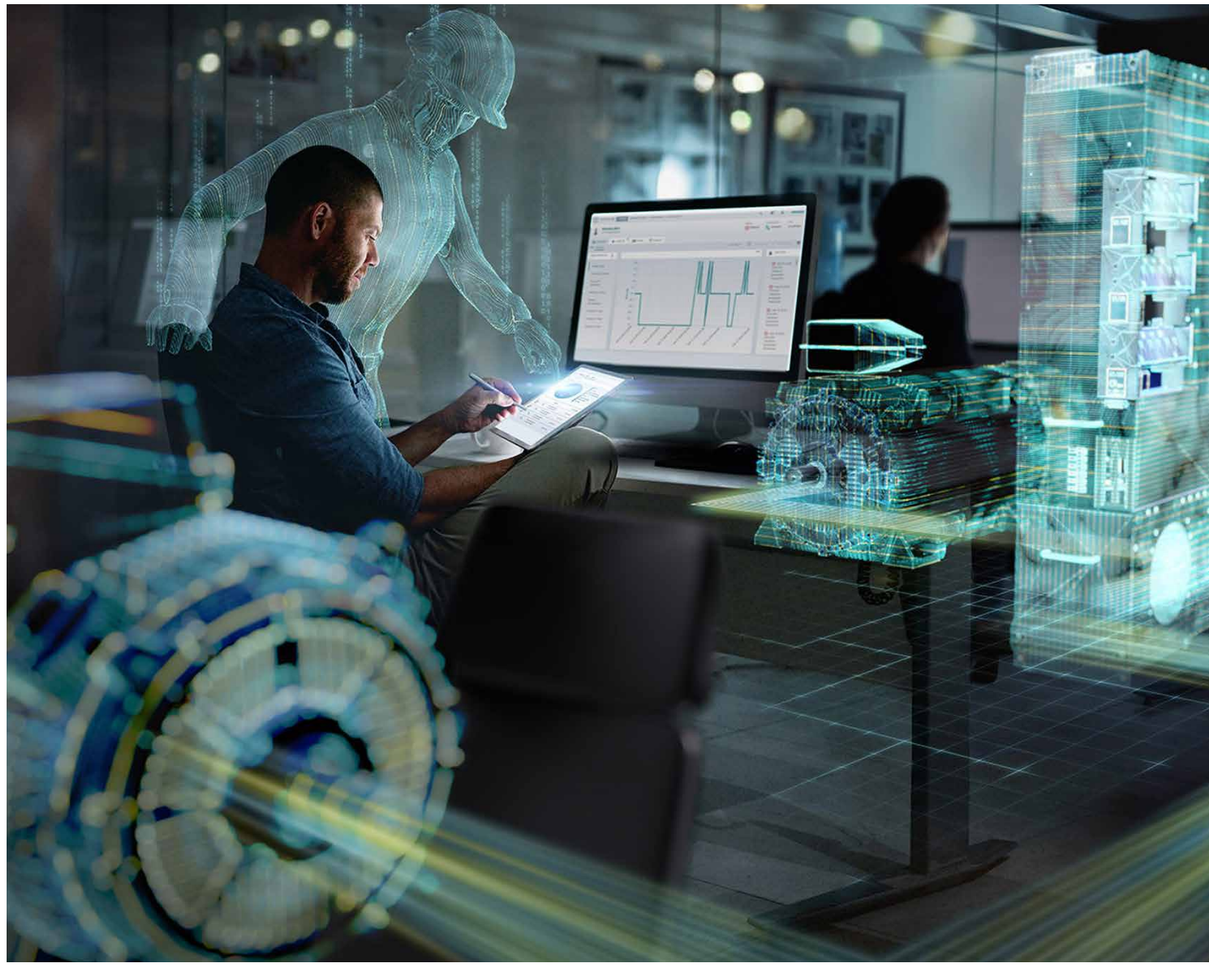
Jason Kuang
Head of Digital Industries, Siemens Hong Kong and Macao

data collection, analysis, and presentation to discover data insights with digital transparency. Leveraging advanced IoT and cloud technology, Siemens' Manufacturing Execution System (MES) offers a holistic approach which facilitates data collection and real-time data analysis throughout the production process to facilitate advanced features including early fault detection and predictive maintenance to minimize unplanned downtime and promote cost-efficiency. Coupled with a comprehensive dashboard, customers can control their plants remotely anytime, anywhere, making it especially convenient for companies with production lines and sites across different locations.

"Through exploiting the power of IoT, MES allows customers to forecast changes and fluctuations in demand and better manage their capacity, which enables facility managers to make data-driven and well-informed decisions. There are already successful cases of Siemens' MES in action." Jason adds, referencing Siemens' strategic cooperation with Swire Coca-Cola China on a customized Manufacturing Information System (MIS), which was launched in Hangzhou and expected to unlock an annual production capacity of 550 million cans of Coca-Cola. "In Hong Kong, we are also heading in the same direction to provide customers with MIS. I look forward to seeing how we can digitally transform the production processes in the city." Jason says.

Leveraging digital twin for improved efficiency

To digitally transform the entire industry, motors as the smallest and most common unit can be the starting point – this begins with collecting data. "Equipped with easily installed IoT sensors, large volumes of operational data like rotation speed, temperature, and vibrations can be collected and uploaded to the cloud platform. From there, digital twin can be created to simulate every aspect within factories: from machines to plant controllers to entire production lines in the virtual environment," Jason explains. "As a result, sources of error or failure can be identified and prevented before actual operation begins. This saves time and lays the groundwork for customized production, because even highly complex production routes can be calculated, tested, and programmed with minimal cost and effort in a very short time."



Under the new normal, reliability, resilience, and sustainability are especially important in the industrial sector when facing unprecedented challenges; digital twin solutions bring immense scalability and flexibility to facilitate optimization of production processes and plant health monitoring, paving a more energy-efficient pathway for the future.

"As an innovation leader set on transforming our industries, we recognize the potential of digitalization and automation as game changers that will enable us to meet such challenges on the way to Industry 4.0, and we have already been making remarkable progress," concludes Jason. "There is immense potential for us to ride on this trend and create sustainable industrial innovations for a world we want to live in, today and tomorrow. In addition to the recently launched Siemens Xcelerator, an open digital business platform, we are starting the journey towards next-generation software architecture to accelerate digital transformation in Hong Kong."

How AI is cooling **data center operations**

Dynamically match cooling to IT load in real time

Artificial Intelligence (AI) offers data centers promising solutions to improve operations over the long term. In fact, Gartner analysts predict that the early adoption of AI will be a key factor separating data centers of the future. This article explores the impact of AI on data centers, using White Space Cooling Optimization (WSCO) as an example of how AI can be implemented today. Starting with a look at the changing data center landscape, it provides a glimpse into what the future holds and examines the critical aspects of thermal cooling, specifically thermal optimization. This article also focuses on how a data center can easily begin integrating AI into its processes through WSCO and reviews how a Hong Kong's data centre is using WSCO as its thermal optimization plan, with promising results.

The simplicity of WSCO's agnostic infrastructure design makes it responsive and scalable to meet future demands.

White Space Cooling Optimization

What is AI?
Artificial Intelligence (AI) is the creation of human-like intelligence using computer-based algorithms. AI systems are based on three types of computer-based machine learning: supervised learning, unsupervised learning, and reinforcement learning. White Space Cooling Optimization (WSCO) uses supervised learning, where you train the machine to use data that is "labeled". In other words, the computer is fed data that is tagged with correct answers to potential questions or scenarios. Its algorithm learns from this labeled training data how to map answers between input examples (questions) and the target variable (best answers). The algorithm then teaches the computer memory to how to predict outcomes from similar, unforeseen data and respond to future events.

Where can AI provide immediate results?
One area where AI can immediately deliver real benefits is data center cooling and control. Managing airflow is also complex, especially with the dynamic nature of data centers and the unpredictable demands of IT equipment. Added to this is the fact that on average, 20% to 30% of servers in large data centers are unused or obsolete but still consume electricity. They also create excess heat and drive higher demand for cooling throughout the data center. As a result of all these factors, most data centers are overcooled, wasting valuable resources.

The answer: thermal optimization!
Thermal optimization is a comprehensive solution that eliminates the need to manually maintain the optimal, cool and consistent temperatures required to house data center equipment safely. Its benefits go beyond temperature control to include the optimization of energy use and personnel time to better manage resources. Thermal optimization features a package of facility improvement measures based on data collection and analysis. The performance of everything from the cooling tower to the rack is measured and approved. The solution also applies intelligence about the density of IT workloads to regulate the cooling within a data center. The goal is to optimize primary and secondary cooling cycles as well as the temperatures within the "white space" – the unusable square footage of a data center.

Benefits of thermal optimization
By optimizing chilled water cooling (Demand Flow) and WSCO together, thermal optimization can help a data center achieve more savings than using one or the other solution individually. The combination delivers many benefits, including:

1. Collecting indoor environmental data in real time and providing valuable insights for making short- and long-term operational decisions
2. Freeing up capacity and better positioning data center workloads
3. Providing dynamic control and energy savings by managing thermal airflow
4. Enabling systems to adjust in real time to match facility cooling needs as IT loads change
5. Maintaining optimal performance by dynamically controlling pumps, chillers and fans
6. Optimizing central plant operations to achieve energy savings up to 50%

AI and WSCO
AI is what makes WSCO so effective in improving temperature control and cool air distribution with less staff support. WSCO's AI engine utilizes a type of machine learning known as supervised learning that enables the WSCO software to continuously get smarter based on the calculations of a series of algorithms. The software learns by continuously analyzing the sensor data for environmental changes. Past and current records of temperature control data are used as a basis for the algorithms and to establish baselines. The software quickly learns how to best respond to temperature variations. The backbone of WSCO consists of a wireless mesh system with a dense array of sensors and controllers that fuel the powerful analytics and machine learning process.

Rack-level sensors capture both top and bottom rack temperatures while cooling unit controllers provide data such as supply and return temperatures, status, speed, and cooling unit power. This data helps identify cooling influences on the racks so that WSCO's learning software can dynamically determine how much cooling is needed for ideal conditions.

> The AI engine uses real-time data to produce algorithms that predict the best level of cooling, delivering the desired temperature at each sensor.

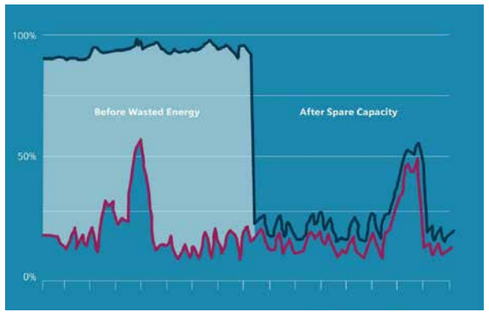
Leveraging data collected by the sensor network, WSCO's AI engine automatically creates a real-time model of the facility's thermal environment. The AI engine maps influences and determines the precise cooling influence of every Computer Room Air Handling (CRAH) unit, both individually and collectively, at every spot across the data center. In most facilities, the AI engine is able to identify influence patterns and measure cooling influences in less than 24 hours.

The WSCO system then takes dynamic control of the cooling units – turning them on and off, and ramping fan speeds up and down – to meet pre-specified temperature settings in the most efficient manner possible. As the AI software learns the effects of control actions, it manipulates the cooling equipment by itself without staff intervention, automatically managing cooling and balancing airflow in critical areas in the data center hall.

In the event of a system failure or when temperatures exceed a certain threshold, the WSCO system has a "guard mode" that activates cooling. The "guard mode" delivers added protection to the data center until the mechanical system returns

to normal operation, all driven by the automated and learning algorithms.

WSCO solutions are infrastructure agnostic, so they are immediately compatible with existing systems with minimal on-site configuration and setup. The WSCO wireless architecture makes installation non-intrusive and flexible. Without the need to run hundreds of cables, even large sites can be up and running in a matter of weeks.



WSCO's impact on air cooling efficiency

The major success of WSCO is its ability to dynamically match cooling to the IT load in real time. With real-time data, the AI engine produces algorithms that predict the best level of cooling and deliver the desired temperature at each sensor. Since most facilities are overcooled, WSCO uncovers redundancy and redirects airflow while level sets cooling capacity and delivers significant energy reductions.

Building toward the future

Combined with other emerging technologies, AI will reshape data center operations in the coming years. AI-managed thermal cooling solutions like WSCO help data centers lay the groundwork for the future. These solutions help managers address today's challenges – personnel management, operating costs, operational efficiency and energy efficiency – while preparing their operations to adopt other new AI applications. The simplicity of WSCO's agnostic infrastructure design makes it responsive and scalable to meet future demands. It's an AI application that is ready to be implemented today and a smart investment for long-term operational excellence.

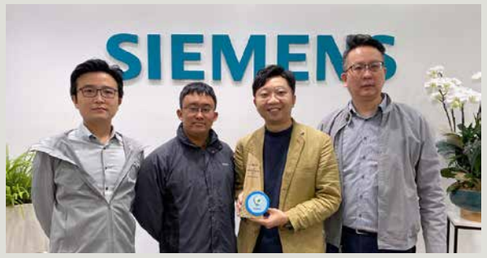
Case Study : WSCO at Hong Kong's data center

Our client, the world's digital infrastructure company, set up its Hong Kong data center to serve business hubs for over 500 companies where customers can choose from a broad range of 80+ network service providers. As one of the leading regional internet exchange and most carrier dense network hubs in the country, it faced the challenges that many data centers encounter – high energy consumption from cooling and installation difficulties at sites.

Siemens White Space Cooling Optimization System (WSCO) integrates almost a hundred computer room air conditioning units. With a few hundred sensors installed, facility managers can dynamically match cooling with IT loads based on real-time data. By deploying a network of sensors, cooling unit controls, and an AI engine, cooling distribution is optimized automatically on rack-level based on predicted cooling load.

Having avoided overcooling, the overall energy efficiency is enhanced by over 20%. The real-time airflow model also provides insightful data to streamline operations and even uncover new IT capacity for future expansion. Additionally, by enabling intelligent maintenance, the data center is now more reliable than ever.

Harnessing the power of AI, our customer won the Grand Energy Saving Performance Award under the CLP Smart Energy Award 2021 with Siemens' WSCO system. This recognition has demonstrated our ability in unlocking the power of AI on data center operations and delivering excellent project execution.



The power of **real-time visibility**

The scalable RTLS enables seamless real-time positioning, precisely locating relevant assets in facilities. High accuracy and visibility in locating data can be used to create a digital twin, enabling a real digital transformation.

Today's megatrends push every business to be more competitive than ever. For this reason, deploying a real-time locating system (RTLS) can provide visibility into what is happening in a factory, facility, or premise. Coupled with software analytics and AI, companies can visualize the movement of an object and be alerted immediately if things do not go as planned.

RTLS boosts efficiency, visibility and safety

Companies can start their RTLS by deploying a small number of RTLS gateways around their facility to capture real-time data regarding the whereabouts of tools, parts bins, large subassemblies, or even personnel. RTLS is so scalable that the company can decide on its locating solution according to its needs. As a company uses more transponders on items and installs more gateways, greater location accuracy can be achieved, enabling the creation of a digital twin – a digital version of a facility.

The solution can also be used to improve or speed up maintenance processes. When a machine goes down, managers can use the RTLS data to summon the closest maintenance personnel to fix the problem. That person could be given the precise location of the specific machine facing an issue, thereby reducing the amount of time wasted.

In addition, a RTLS software can automate tasks with programmable logic controllers (PLCs). Siemens recently deployed a solution with tagged automated guided vehicles (AGVs). As each AGV approaches a gate, the RTLS detects its presence and opens the gate before the vehicle arrives so that it will not need to slow down.

Safety checks and documentation can also be triggered, based on location. This kind of automation provides factories or facilities with a new level of efficiency, as well as command and control.

Choosing the right technology

There are a variety of RTLS that can locate objects in real time or nearly real time within a facility. Some operate at 433 MHz or 2.4 GHz, some use Wi-Fi access points, bluetooth beacons or even GPS. Each system has its own advantages and disadvantages. A typical RTLS using only 2.4 GHz transponders can locate a tagged object to within about 3 meters. Siemens' SIMATIC RTLS features transponders that operate at this frequency for which precise positioning is not required. To acquire highly accurate location data, the SIMATIC

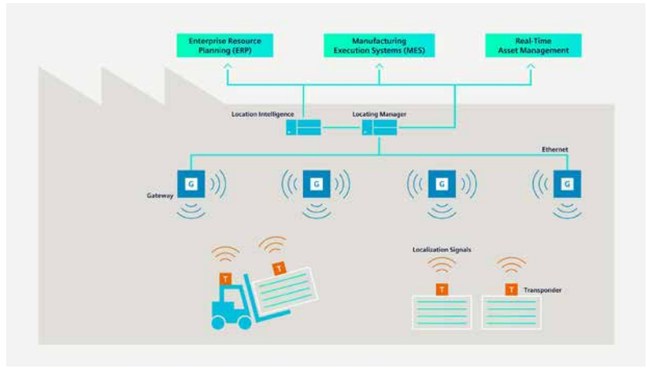
> SIMACTIC RTLS utilizes ultra-wideband transponders can be located to within 30cm with 99.9% reliability.

Real-time locating system

RTLS can utilize Ultra-wideband (UWB) transponders that can be located within 30 centimeters with 99.9 percent reliability.

The central processing instance for SIMATIC RTLS from Siemens is the Locating Manager, with which the user can operate and manage the RTLS. If a factory floor were reorganized, an IT person would then update the layout in the Locating Manager, enabling items to be located on an accurate representation of the factory floor.

Business users can utilize Siemens' Location Intelligence, which offers front-end software for mapping and geofencing. Both come with graphical user interfaces. The system also has application programming interfaces (APIs) for SAP and differernt manufacturing execution software applications, meaning data can be transferred easily to a company's existing IT system.



Seamless locating on the entire company premises with RTLS infrastructure.

The highly accurate location data collected via UWB RTLS can be used to create a digital twin, to display the objects which are associated with transponders. Once they move, the RTLS data will show their location in real-time. By setting up rules associated with tagged objects, managers can even receive alerts when people without proper certification operate a tool or a parts bin were brought to the wrong station.

Best of both worlds –
High accuracy and no interference

SIMATIC RTLS has been designed for maximum flexibility, applicable for a wide variety of use cases within the same facility. Its portfolio includes a large number of transponders, each with different typical areas of application. The

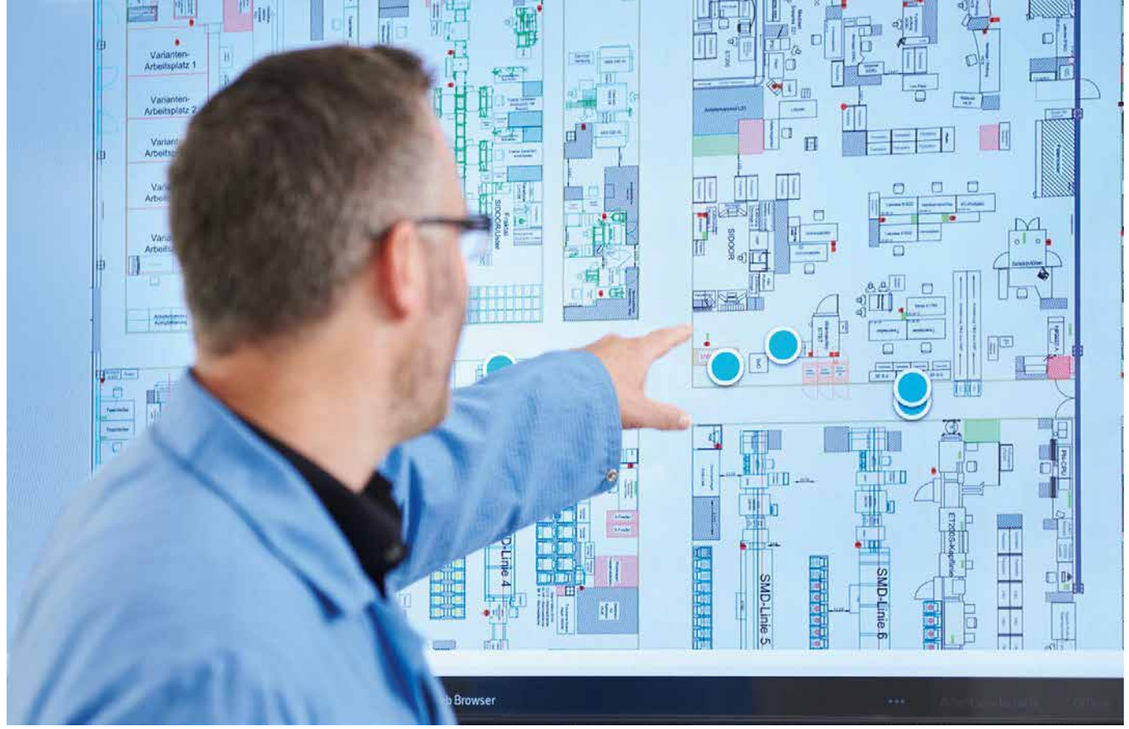
SIMACTIC RTLS infrastructure has been designed for maximum flexibility.

SIMATIC RTLS transponders are also small enough to avoid impacting facility operations.

During a locating event, the transponder emits a signal containing identifiers of the transponder and the event itself, as well as the time of the event and other data, if available. The signal is received by a net of infrastructure devices called gateways. The gateways, which are mounted in a fixed and known position, add a time stamp to the signal and then forward it to the server. The Locating Manager server uses the position of the gateways together with the two-time stamps from the signal to calculate all possible positions of the transponder while three gateways are enough to determine the transponder's location.

Ultra-wideband technology is particularly crucial in the industrial environment. The radio signal is high quality and provides very accurate distance measurements to ensure location accuracy. Alongside its ultra-high precision, UWB does not interfere with other wireless networks employed within facility systems due to low-power transmission and a not commonly used frequency range. To coexist with other systems, the transponder has a chip that operates at 2.4 GHz. It can be used for data communication, firmware upgrades, data and commands transmissions to the Locating Manager over long distances. This enables the best of both worlds: highly accurate and robust positioning without interference with existing RF systems.

The SIMATIC RTLS is designed to be highly configurable, so it can be used for a wide variety of applications within a facility. The frequency used by the transponder, the data rate, and the



Full transparency with RTLS solution.

interval at which it broadcasts can all be controlled. All SIMATIC RTLS transponders contain a motion sensor that can be set up to trigger an action if an object is moved or to issue an alert if an object hasn't moved for a specific period of time. This feature can be used to increase asset utilization, by showing workers and managers where tools not being used are located.

The transponder can be set to beacon at different rates, depending on the application. If highly accurate real-time information is required, the transponder can send out a signal continually. On the other hand, if an object moves infrequently or the precise location is not needed in real-time, the transponder can be set to send out a signal once every few seconds or minutes.

Tapping into the digital future

Taking the RTLS to the next level, the solution can be combined with other systems to achieve greater efficiency, leading to a higher level of digital transformation.

Automated Guided Vehicles (AGVS) and Robots

In the near future, AGVs and robots will be able to integrate what they have learnt and use patterns to improve their performance. Today, an RTLS can track AGVs and help to optimize their routes. But it will be possible to also provide AGVs with RTLS data, enabling them to "see" potential obstacles and learn from similar situations in the past. These will also benefit from having real-time data regarding the locations of not just the objects they are retrieving, but those that might end up in their way. Combining advanced robots with RTLS data enables the robots to work faster and smarter, making more effective business decisions.

Internet of Things (IoT)

Many objects within a factory – tools, machines, containers – have or will soon have RF sensors that will provide data about their condition and / or the condition of the environment around them, and will enable them to communicate with one another. IoT device data, combined with real-time locating data, will enable factories to better manage inventory, assets, personnel, and more. A tool that is overheating, for example, might communicate that data to other IoT devices, which would then relay that information to a back-end system. RTLS data can tell a technician precisely where a tool in need of maintenance is located. Combining IoT data with RTLS data can help companies to improve efficiencies, boost worker productivity, and reduce risk by enabling preemptive maintenance.

Details on RTLS

Preventive fire protection in **electrical installation**

Existing electrical installations are hardly capable of meeting growing demands nowsdays, causing failure of electrical loads to electrical fires. This article illustrates the potential risks from electrical installation and possible preventive fire protection that aligns with the latest standards.

Failure of electrical loads causes serious injuries and property damage

The electrical installations in many existing buildings were configured decades ago and have not been adapted since. In Germany, 30 million residential buildings are more than 35 years old. Yet, the average service life of electrical systems is only 30 to 35 years. When buildings are overhauled, the electrical installations are often neglected. A similar picture exists in commercial and industrial buildings.

New risks through new technology

Largely, this does not take into account that the number of electrical loads has drastically increased over the past decades: Whereas there used to be roughly eight electrical devices, today there are often more than 70 electrical loads in a given household. The outdated electrical installations in many buildings can hardly cope with these loads anymore. Another point to consider is that modern electrical devices often have different power consumption characteristics or have frequency converters. In the event of a fault, these can create residual currents with higher frequencies or smooth DC residual currents, requiring special protective devices, of which many people are unaware.

What's more, the antiquated electrical systems designed for the range of appliances in the 1960s and 1970s can hardly be connected to the Smart Grid or regularly supply electric vehicles with electricity over a longer period of time. That is why the modernization of electrical installations is not only the prerequisite for electrical safety, but also the basis for sustainable energy concepts.

Types and possible causes of arcing faults

So-called arcing faults in electric cables or systems are among the most frequent causes of fires. We distinguish between serial and parallel arcing faults. Parallel arcing faults occur between phase conductors and earth or a protective conductor (PC), between two-phase conductors, or between a phase conductor and a neutral conductor. Serial arcing faults can be caused in the event of an interruption in a conductor or as a result of loose contacts.

The most common causes of serial arcing faults include damaged cable insulation, crushed cables when laid through open doors and windows, cable breakage due to excessively tight bending radii, kinks in plugs and cables, and loosened contacts and connections in switches or socket outlets.

Additionally, environmental influences such as heat, moisture and gases can affect cables, as can UV radiation and rodents if the cables are outside. Conductive soiling and condensation can also give rise to undesired contact.

If damage to a cable causes a narrow point where the cable has a reduced cross-section, this can lead to a temperature increase when the cable is subjected to current loading, which can in turn lead to the oxidation of the hot copper and the formation of copper oxide. The insulation is then heated and carbonized. As the heating becomes more intense, the copper melts and gasifies, creating an air gap and causing sporadic arcs to occur. At around 6,000 °C, these can stabilize via the carbonized insulation.

Comprehensive experiments into the origins of serial arcing faults at the normal European voltage of 230 volts (V) and using the most common cable type in Germany, NYM, yielded the following results: fault locations need a certain level of energy to carbonize and to reach significant arc stability. The time taken for flames to occur depends greatly upon the load current. For currents under 3 amps (A), arcs are very unstable, with only a glow usually visible. However, over a longer period, this can carbonize the fault location

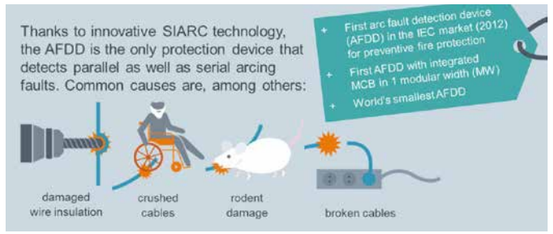
such that a stable arc forms for a period lasting between a few tenths of a second and a few seconds. The ignition energy for this lies at around 300 joules. At currents below 2 A, even a stable arc frequently does not have the power required to ignite the cable.

The probability of hazardous arcing faults occurring is greatest in the mid-range between 3 and 10 A, and the majority of common domestic electrical appliances fall into this category. Here, the occurrence of the first significant flames (i.e. sustained flames lasting over 5 or 50 ms) lies at around 80%. In the upper range above 10 A, the power of the arc is so high that flames occur very quickly and without carbonization. On the other hand, the arc stability is extremely low. At the same time, the probability of significant flames lies below 35% and the probability of stable flames below 5%. One reason for this is the vaporization of the carbonized material, which prevents the formation of a carbon path. Moreover, high-power serial arcs sometimes melt the two copper conductors back together and "repair" the fault point. Even if stable arcs above 10 A are rare, the brief and powerful flames that can occur in this range, however, represent a serious danger.

Detection of arcing faults

A portfolio of interacting protective components geared towards personal, line, and preventive fire protection is required for the complete protection of electrical installations. Miniature circuit breakers and fuse systems are designed to protect cables, systems and devices in case of overload and short-circuit. They disconnect the current, depending upon the fault impedance, usually between phase conductors or between a phase conductor and a neutral conductor in the event of parallel arcs.

Residual current protective devices (RCDs) protect against dangerous electric shocks from indirect and direct contact by disconnecting the monitored circuit quickly and safely from the mains supply when a certain residual current is exceeded.

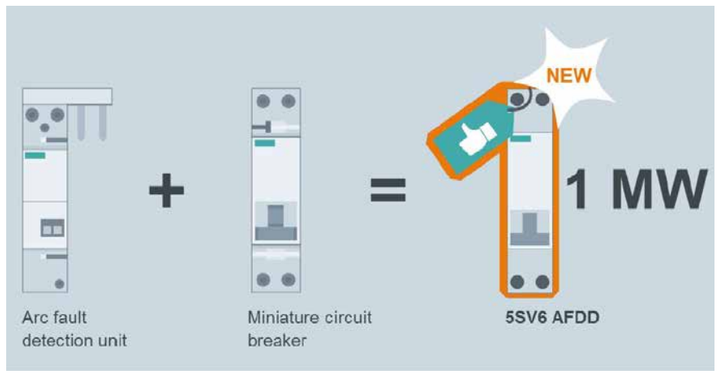


The cause of the fault can be a defective electrical device, for example. Residual current operated circuit breakers (RCCBs) detect residual currents and arcing faults to earth and can provide additional fire protection in this case, depending upon the rated residual current. For many areas of application, the installation of RCCBs with rated residual currents of maximum 30 mA has therefore become mandatory in new buildings: for example, since 1984 in rooms with a bathtub or shower (DIN VDE 0100-701) and since 2009 also for all socket outlet circuits with a rated current up to 20 A if they are intended for use by non-experts and for general use (DIN VDE 0100-410).

AFDDs for preventive protection

These standard protection devices available to date cannot detect serial arcing faults as these faults do not lead to an increase in the load current or to a residual current. If parallel arcing faults occur in connection with very high system impedance, the flowing current in the case of a short-circuit may, however, lie below the tripping characteristic of the overcurrent protective device, meaning a shutdown is not triggered or triggered too late.

AFDDs (arc fault detection devices), as offered by Siemens with the 5SM6 AFD unit and 5SV6 AFDD, close this previous safety gap. The devices are capable of detecting all types of arcing faults. Based upon technology that has been tried and tested for many years in the U.S., they not only detect current and voltage. The AFDD from Siemens also continuously measures the level, stability and duration of high-frequency



noise. Thanks to the patented SIARC detection methodology. Integrated filters work with intelligent software to process, analyze and evaluate these signals according to numerous criteria in order to determine, for example, the total energy, arc energy, plateau arc voltage, arc stability and flame occurrence. If the conditions for an arcing fault are fulfilled, the connected circuit is shut down within a fraction of a second. Fire hazards, from electrical cables to terminal equipment, can thus be recognized and prevented at an early stage.

With the 5SM6 AFD units, which can be combined with MCBs or RCBOs, Siemens has offered preventive protection in the IEC market against hazardous serial arcing since 2012. As an innovation, the 5SV6 AFDD is now the smallest arc fault detection device worldwide: the new version is the first device on the IEC market with an integrated miniature circuit breaker in only one modular width (MW). The 5SV6 is thus not only easily installable in new buildings, but as the first product for preventive fire protection, it also features straightforward retrofitting in existing buildings. The standards-compliant extension of the electrical installation to include protection against electrical fires is thus quickly possible at any time.

Arc-fault protection in the standards

In the U.S., AFD units are known as AFCIs (arc-fault circuit interrupters) and have been mandatory for many years now. The International Electrotechnical Commission (IEC), the European Committee for Standardization (CENELEC), and the German Commission for Electrical, Electronic & Information Technologies (DKE) have also recognized the urgency of the matter and adopted arcing fault protection as a recommendation:

The new standard IEC 60364-4-42 strongly recommends the installation of AFDDs in specific locations of use as the recognized state-of-the-art technology.

with the publishing of the German standard DIN VDE 0100-420:2016-02 "Low voltage electrical installations – Part 4-42: Protection for safety – Protection against thermal effects", the installation of AFDD has become mandatory as the state-of-the-art technology for many locations.

The DIN VDE 0100-420 standard describes the requirements for the protection of humans, assets and plants against thermal effects and fire hazards due to faults in electrical equipment and systems. It is to be used for new installations, as well as for expansions of existing electrical installations.

Section 421.7 has been supplemented in the new version of the standard. It describes the deployment of so-called arc-fault detection devices, i.e. AFDDs. With the adoption of this protection device, the deployment of AFDDs became a generally accepted engineering practice, and its installation is now mandatory for the following applications in single-phase alternating voltage systems with an operational current not higher than 16 A:

1. In bedrooms or recreation rooms in care homes or daycare centers for children, disabled and old people
2. In bedrooms or recreation rooms in apartments with unhindered access according to DIN VDE 18040-2
3. In rooms and other locations

- Posing a fire risk due to processed or stored materials (as detailed in Section 422.3 of the standard)
- With flammable building materials (as detailed in Section 422.4 of the standard)
- In locations where irreplaceable goods are endangered (as detailed in Section 422.6 of the standard)

This also includes wood-processing plants, paper and textile factories, wooden houses, laboratories, public buildings, museums, railway stations and airports. The installation of AFDDs is recommended in additional areas, for example, in all rooms with sleeping quarters, or for rooms or locations with fire-spreading structures (e.g. in high-rise buildings).

To know more about AFDDs

Circuit protection devices with **communication and measuring function**

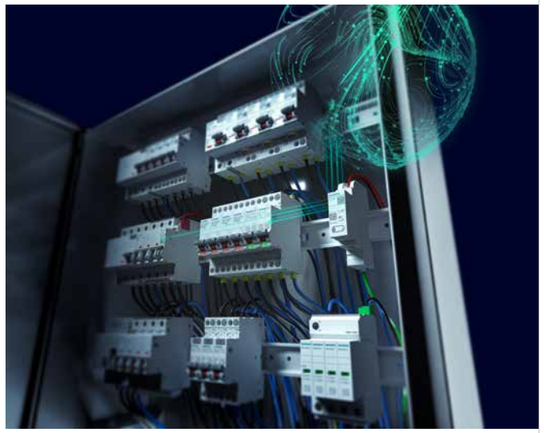
By using communication and measuring capable circuit protection devices, operators can minimize power interruptions, optimize energy monitoring, and use condition data to replace circuit protection devices in time.

Faults in electrical installations can damage or destroy electrical devices, lines, and their surroundings. For this reason, circuit protection devices like miniature circuit breakers (MCBs) and arc fault detection devices (AFDDs) are used to protect power circuits. In the event of failures, they automatically disconnect the circuit from the supply network and may lead to downtime of production plants or power outages which cause high financial damages.

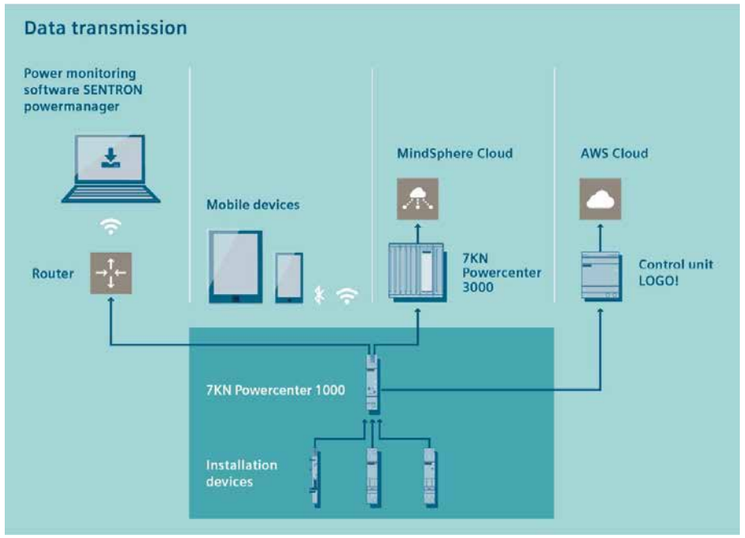
Versatile use for measured data
Communication and measuring capable circuit protection devices are equipped with measuring and communication functions. These allow them to detect and report imminent failures at an early stage so that operators can take counteractive measures and prevent a switch-off of the electric circuit. The measured data is not only used for condition monitoring but can also be utilized for the predictive maintenance of plant components. Many of these features can be used on conventional, non-communicative devices by installing communication and measuring capable auxiliary switches / fault signal contacts. In addition to condition monitoring and fault detection at an early stage, communication and measuring capable protection devices help to increase transparency of the power flow within a low-voltage network. For this purpose, the measured energy values are transmitted via a superordinate data collector for further analyses, e.g., by means of a software or cloud solution.

Increased electricity supply security due to early fault detection
In case of malfunction, the interruption of the power supply ensures the safety of the installation and plant. Depending on the electrical consumer, the consequences of a power outage vary in severity. When a MCB disconnects a final circuit that is connected to a freezer due to overload, switching it back on immediately is crucial. For example, if an automatic switch-off occurs in the evening and the operator only notices it the next morning, perishable products may be spoiled.

Reactions at early stage before failures occurs
MCBs and AFDDs with added communication and measuring capabilities are especially useful in such applications. Not only do they protect electric circuits, they also measure them with regard to electrical current, voltage, temperature, and other metrics. This data can then be used to calculate energy and power values and make assertions about the load as well as a possible overload of the electric circuit. As soon as the preconfigured threshold value, e.g., 80 % of the rated current In, is exceeded, the operator receives an alert and can then proactively rectify the fault. The internal temperature measurement system of a communication and measuring capable protection devices gives conclusion of the malfunction of equipment.



Early warnings enable operators to minimize downtime. Plant operators can increase plant availability whereas building owners benefit from a high security of supply which makes their real estate more attractive to tenants.



Examples of data transmission

Increased system availability through early reaction and predictive maintenances

Apart from the operating time, the actual wear of a circuit protection device depends on how often it is triggered or switched. Thus, manufacturers often specify the service life of their devices in the number of switching cycles. If, however, the device is not equipped with a switching cycle counter, tracking switchings and triggers can be difficult for operators. This may result in an imprecise maintenance schedule and devices being replaced either too early or too late. A switching cycle counter on the other hand enables the device to send an alert to the operator once reaching a certain amount of switchings. The operator can then replace the device before it reaches the end of its service life. In this way, unplanned plant downtime can be avoided.

Safe plant due to switch position and predictive maintenance
The new communication and measuring capable circuit protection devices include these kinds of measurement functions which visualise the device's condition. For instance, the devices indicate whether a switch is in the "on" or "off" position. In combination with a handle lock which prevents power from accidentally being switched back on, the indicator allows maintenance personnel to ensure the system is disconnected from the power supply while they are working on it.

Maintenance requirements are identified early on due to condition monitoring, enabling proactive planning and efficient coordination of maintenance procedures. Thus operators can minimise maintenance-related downtime.

Avoiding failure of the system due to early reactions
Measuring and communication capable circuit protection devices differentiate between overload and short circuit. In the event of a short circuit, they quickly and safely disconnect the circuit from the power supply. If, instead, a slowly rising current indicates an overload of the circuit, the device will alert the operator when exceeding the set limit value. He can then act accordingly to prevent a shutdown of the circuit.

Streamlined, targeted and timesaving troubleshooting as well as systematic plant optimization hooting
By differentiating between deliberate switch-offs and triggers due to a fault in the circuit, communication and measuring capable circuit protection devices with measuring functions reveal which plant components impair system availability disproportionately due to frequent triggers. Consequently, optimization measures can be applied where they promise the greatest benefits.

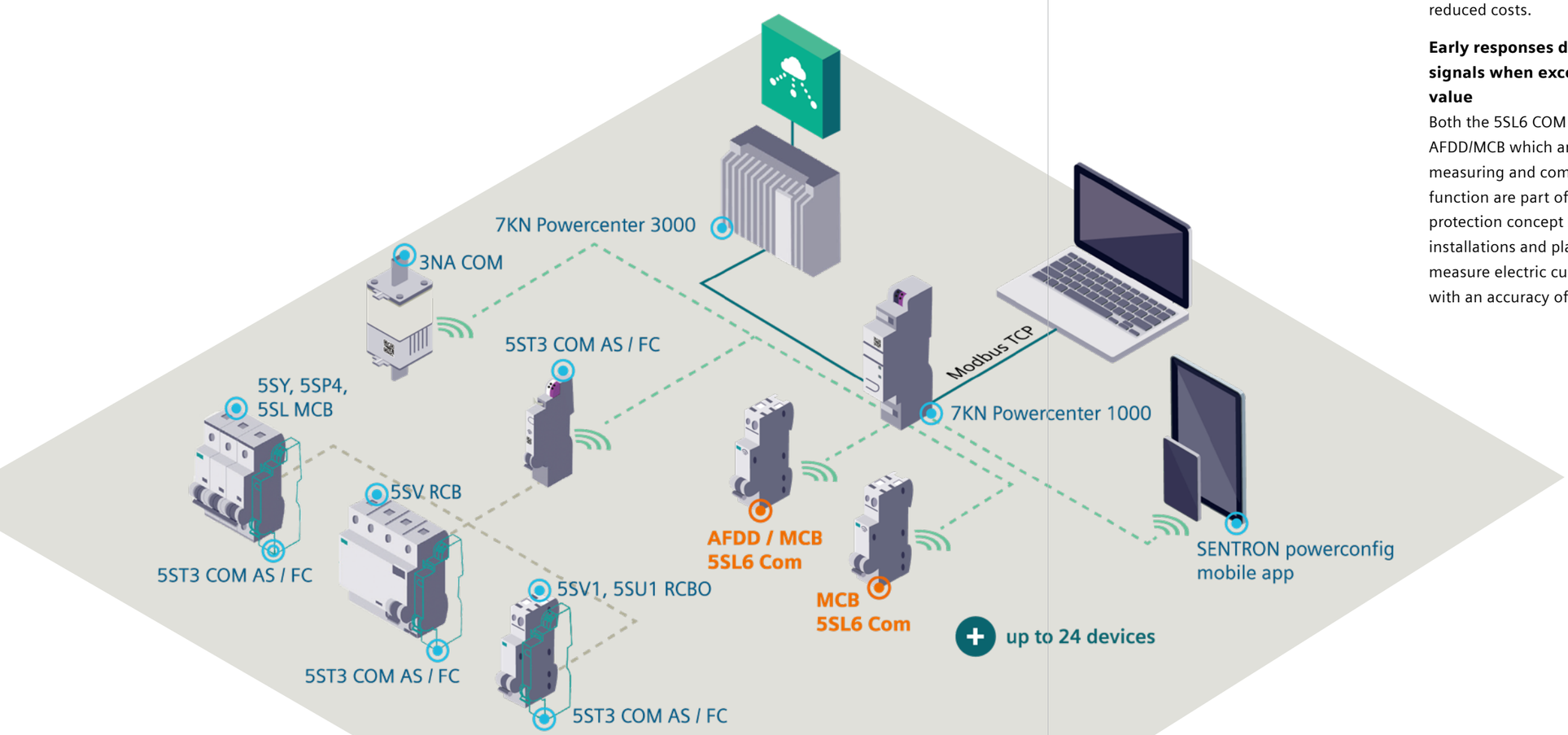
For operators, differentiating between different types of faults whether a short circuit or an overload caused a trigger facilitates a systematic approach to troubleshooting. This reduces both the amount of work required for troubleshooting as well as the duration of the power outage.

Easily plan and install communication and measuring capable protection devices

In order for them to present a reasonable alternative to conventional protection devices for operators and planners, communication and measuring capable protection devices need to comply with all relevant standards. Moreover, the costs and time effort it takes for planning and installing them in new or existing installations should be as low as possible.

Communication and measuring capable devices from the Siemens SENTRON portfolio including the 5SL6 COM MCB or the 5SV6 COM AFDD with an integrated MCB comply with IEC/EN 60898-1 and meet all relevant installation regulations of the DIN standards. With a short circuit breaking capacity of 6 kA they can be integrated into all common final electric circuits that require MCBs and AFDDs.

Protection devices with communication and measuring functions also expand the recording of energy consumption down to the final circuits. In this way, they enhance transparency and support operators in meeting standards related to energy management.



Narrow modular width makes for easy retrofits
Planning is supported by the SIMARIS tool landscape as well as extensive CAx data. Even though they include communication and measuring systems, the devices only require one modular width (MW) and can be integrated into installations without needing any particular adjustments regarding spatial distribution. The narrow modular width also makes the 5SL6 COM MCB and the 5SV6 COM AFDD with an integrated MCB ideal for retrofits as they can replace an existing device within the same space. Only one further MW for the data transceiver 7KN Powercenter 1000 is necessary.

Installation and commissioning follow a tried and tested process
Communication and measuring capable devices are easily installed on standard busbars. When using them for a retrofit, the only steps necessary are removing the existing switch, inserting the new one and some slight rewiring. The communication and measuring capable protection devices are quickly and comfortably commissioned using the familiar configuration software SENTRON powerconfig or the SENTRON powerconfig mobile app. Planning and installation process of the SENTRON devices requires little effort. These time savings can be passed on to operators and building owners in the form of reduced costs.

Early responses due to alarm signals when exceeding a limit value
Both the 5SL6 COM MCB and 5SV6 COM AFDD/MCB which are equipped with measuring and communication function are part of a comprehensive protection concept for electrical installations and plants. The devices measure electric current and voltage with an accuracy of 0.5 % at up to 5 % of the rated current In. Energy and power values are measured with an accuracy of 1 % at up to 5 % of the rated current. They also record the temperature and supply frequency. Using the threshold values set by the operator, they send a warning as soon as they detect an error based on the measured values. These early warnings allow operators to take counter measures in time, thereby preventing shutdowns and increasing plant availability.

Plannable maintenance based on condition monitoring data
The counter of 5SL6 COM MCB and the 5SV6 COM AFDD/MCB, and furthermore the 5ST3 COM auxiliary switch / fault signal contact, keeps track of switching cycles and differentiates whether the device was triggered due to an error or was switched off deliberately. The “Power off” indicator shows the position of the switch and thus whether the plant is in a current less state. This wealth of data can be utilized by operators for predictive maintenance concepts. When the switches reach a certain number of switching cycles and need to be replaced, the devices automatically alert operators with an “End of Lifecycle” warning.

Targeted troubleshooting due to differentiation of tripping cause
Both the 5SL6 COM MCB and the 5SV6 COM AFDD/MCB can detect the cause made them trigger. They differentiate between short circuit and overload. In the event of an impending overload, they alert the operator by sending a warning when exceeding the set limit value before the circuit needs to be disconnected from the supply grid. The 5SV6 COM AFDD/MCB also differentiates as to whether it was triggered by a serial or a parallel arc fault.

Fire protection for **Lithium-ion battery energy storage systems**

As the overall demand for energy increases in our modern world, so does the use of renewable energy sources, and this gave rise to the emergence of energy storage systems in balancing out supply and demand fluctuations. Today, lithium-ion battery energy storage systems (BESS) have proven to be the most effective type and, as a result, installations are growing fast. However, Li-ion batteries combine high energy materials with highly flammable electrolytes. Early and reliable fire detection is therefore a must when designing fire protection systems for Li-ion battery systems. Rapid extinguishing is also essential and can be ensured by the use of automated extinguishing systems using an appropriate agent. In light of the situation, this paper discusses the development of a managed-risk fire protection concept for stationary Li-ion battery energy storage systems.

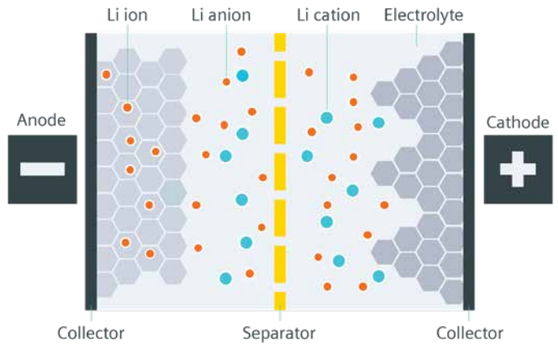
Fire hazards in Li-ion battery storage systems

The risks inherent in Li-ion batteries

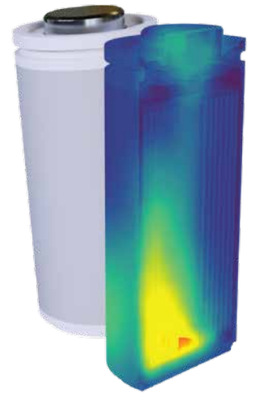
To understand the inherent fire risk of Lithium batteries and the associated storage systems we have to understand the battery technology.

At the heart of the battery system are the electro-chemical battery cells. Each Li-ion cell consists of two electrodes, the negative electrode (anode) and the positive electrode (cathode). The electrodes consist of a collector and an active material applied to it. In between the electrodes is the ion-conducting, typically flammable electrolyte, which acts as a mediator of the processes in the cell and the separator that ensures the electrical separation of the electrodes.

As Li-ion batteries combine high energy materials with flammable electrolytes, any damage to the separator caused either mechanically or by high temperatures will lead to an internal short-circuit with the high probability of thermal runaway. Safety-critical situations are almost inevitable.



Li-ion battery structure



Thermal Runaway

Fire Hazard thermal runaway

The filigree design, the ever increasing energy density and aging of the battery are the causes of the danger.

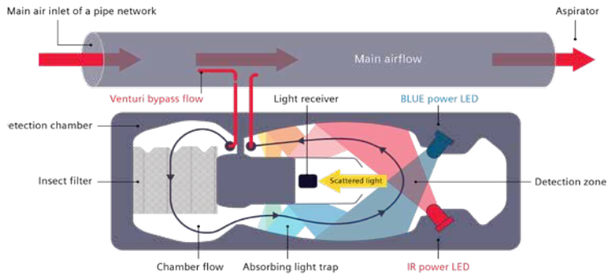
If external mechanical forces are excluded, then a fire caused by battery cells themselves is always due to age-related damage to the separator and a subsequent internal short-circuit. The resulting temperature increase causes the electrolyte, which is usually highly flammable, to start evaporating. As a consequence, the internal pressure within the cell will continue to build up until electrolyte vapor is released either via a relief valve or by the bursting of the shell.

Without countermeasures, an explosive gas-air mixture will be generated: only an ignition source is needed and the result will be an explosion. If the heating is not stopped, thermal runaway will occur.

Fire protection
targets and concept

Earliest possible detection with aspirating smoke detection FDA241

The FDA241 detects electrolyte vapor early and reliably with its patented dual-wavelength optical detection technology.



The aerodynamic design of the Siemens aspirated smoke and "Off-Gas-Particle" detection chamber. A venturi bypass is forcing only a small portion of air into the detection chamber. Smoke and dust particles are detected by a highly sensitive optical measurement arrangement. An optimized chamber airflow assures no separation of smoke and dust particles and prevents surface contamination.

In accordance with normative requirements, two independent FDA241s are required to trigger the activation of the automated extinguishing system that the positioning of the aspiration points must take the airflow generated by the air conditioning system into account.

Moreover, FDA241 serves as the ideal solution for early detection of electrical fires. In addition to controlling the automated extinguishing system, the fire protection system triggers all other necessary control functions.

Safe and sustainable fire suppression and extinguishing with Sinorix N2

Sinorix N2 extinguishing systems extinguish electrical fires, contain initial thermal runaway, stop propagation of thermal runaway and reliably prevent the spread of secondary fires.

Our tests results have shown that the lower the remaining oxygen concentration, the better the protection against thermal runaway.

Sinorix N_2 extinguishing system (left) and FDA241 aspirating smoke detector (right)

Full version of the white paper

Digital transparency made real in **low voltage power distribution**

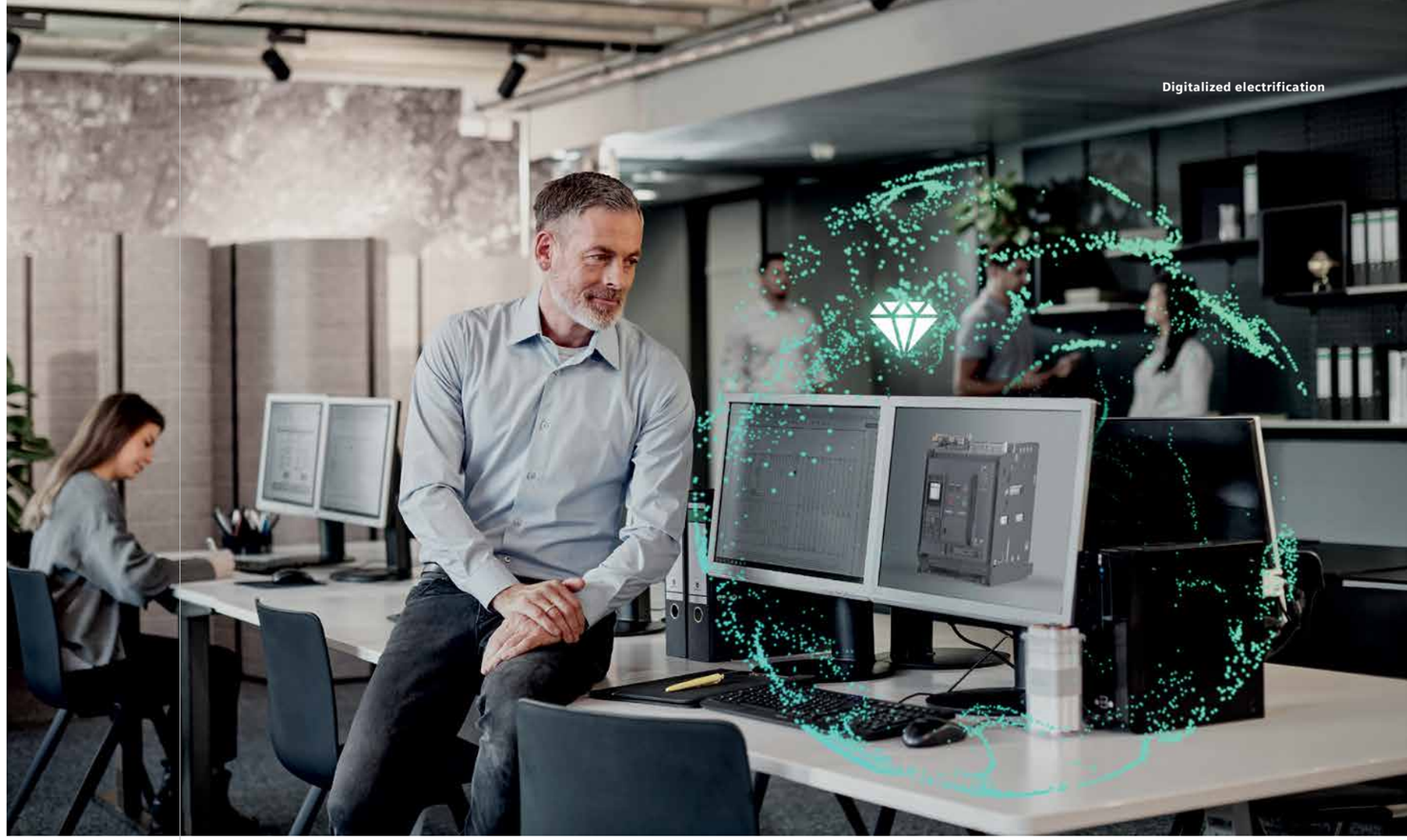
In infrastructure and industry, maintenance tasks are planned well in advance. Instead of scheduling maintenance based on the condition of equipment, such is often arranged in fixed intervals thus rarely coincides with the optimum maintenance time. As power distribution becomes increasingly digitalized, the condition of core components in power distribution like circuit breaker can now be visible to operators, not only enabling transparency down to the final circuit, but also empower operators to know, rather than assume the maintenance requirement with the help of condition monitoring. Here's how.

Condition monitoring in power distribution system

The fundamental principle of condition monitoring is that the technical state of a device is checked on a continuous basis. As physical data such as temperature, speed, pressure, filling level or vibrations are constantly collected, transmitted, evaluated and compared with empirical values, progressive wear of individual components becomes apparent at an earlier point of time. In this way, operators are able to gain deeper insight into the plant, develop a better understanding of its condition and better coordinate the maintenance of the monitored devices.

In the context of power distribution system, the extent of condition monitoring in a specific case depends on the device, its mode of operation and its location. As core components in power distribution, circuit breakers, which among other things, carry uninterrupted current, can open and close the main contacts during operation, and protect against overload and short circuit. The functionality of a circuit breaker must be ensured by condition monitoring. Up to now, the serviceability of circuit breakers could only be estimated on the basis of the following data:

- Electrical operating cycles
- Mechanical operating cycles
- Trippings (the trip counter distinguishes between different reasons for tripping)
- Operating hours (are measured with the operating hours counter)



Meanwhile, in addition to the basic data mentioned, the 3VA molded case circuit breaker can also records the usage pattern of the circuit breaker continuously. Through analyzing and evaluating the data collected with an algorithm, the results can be used to draw conclusions about the state of the equipment. In the 3VA molded case circuit breaker, the patented, intelligent algorithm extends the condition monitoring to include the health indicator and the remaining lifetime.

The health indicator

The serviceability of a circuit breaker depends largely on the contact status of the main contacts. However, switching operations without current, with rated current, as well as at overload trippings and short-circuit releases cause the switching contacts to wear out to varying degrees. The health indicator therefore continuously reflects the condition of the contacts based on data recorded directly in the circuit breaker.

For instance, in the 3VA molded case circuit breaker, the health indicator is determined on the basis of an analysis of the disconnections and tripping operations. Each disconnection and tripping of a molded case circuit breaker changes the state of the main contacts. The state of the main contacts therefore defines the health indicator of the molded case circuit breaker.

In the as-delivered state, the value of this indicator is 100%. The event-related adjustment of the health indicator is activated during commissioning. The indicator value decreases over the operating time depending on the various switching operations and can drop to 0%.

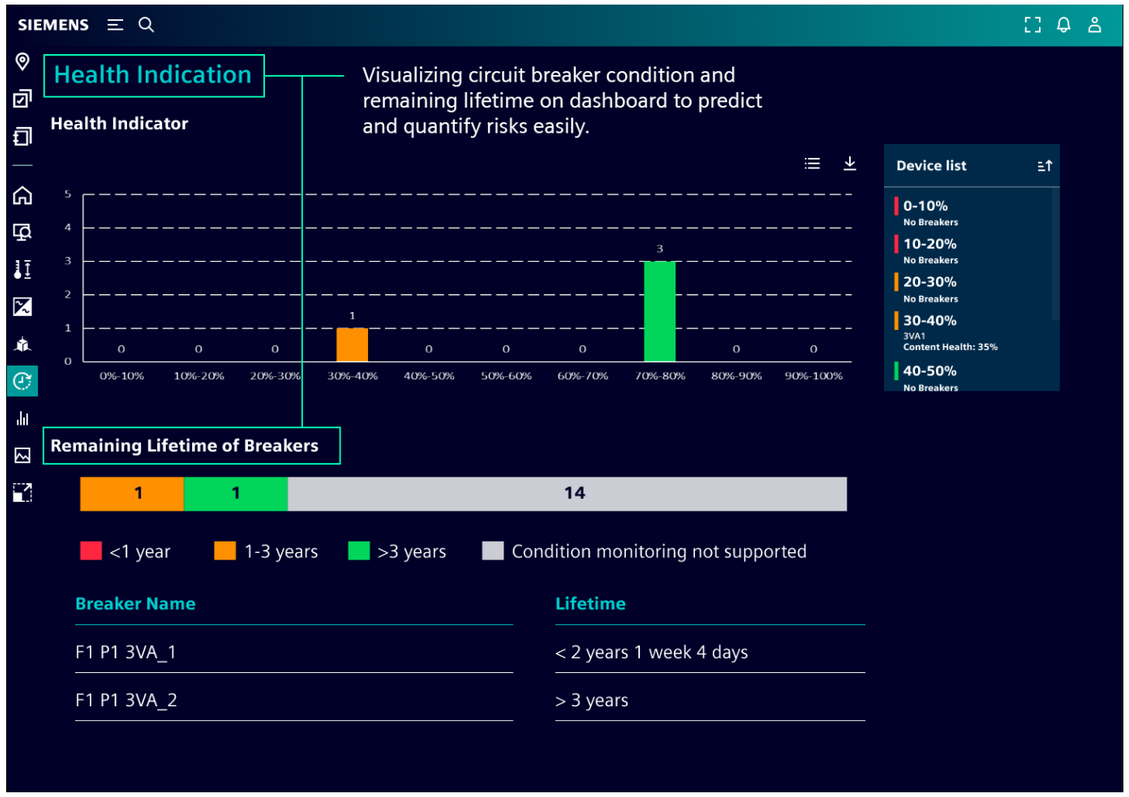
Explanation of the indicator values	
100%	The molded case circuit breaker is in the as-delivered state.
100% to 30%	No restriction on the function of the molded case circuit breaker.
30% to 1%	No restriction on the function of the molded case circuit breaker. However, the maintenance or replacement of the device should be prepared and an appropriate replacement device should be provided. Additional information on the urgency of the replacement can be obtained from the remaining lifetime indicator.
0%	The full function of the device can no longer be guaranteed and the device must be replaced as soon as possible.

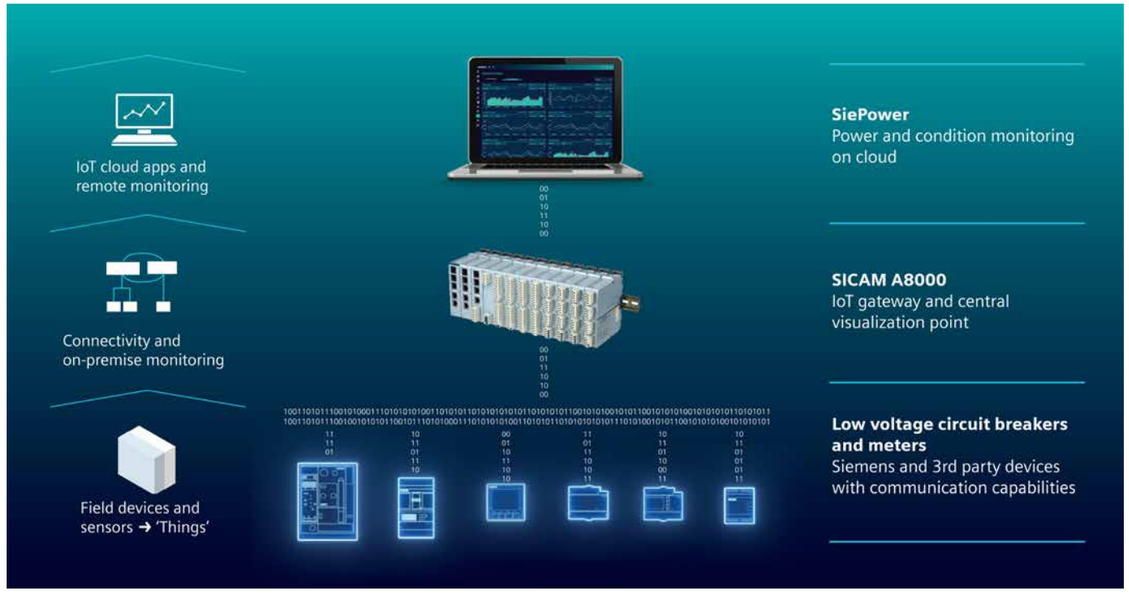
The remaining lifetime

A patented algorithm is used to calculate the remaining lifetime. It analyzes the past usage behavior, projects it into the future, and makes a forecast on this basis. If the usage behavior changes, the remaining lifetime is adjusted accordingly. This is accompanied by the fact that unpredictable trippings can abruptly reduce the remaining service life. They lower the health indicator, which serves as a starting point for calculating the remaining lifetime. The remaining lifetime is determined continuously. If the calculated remaining lifetime is more than three years, the plant operator does not have to take any urgent action such as maintenance or replacement of the device. Hence, it is not displayed in detail. Only a remaining lifetime of less than three years is broken down into years, months and weeks to enable plant operator to have a more precise planning for the maintenance schedule ahead.

Digitalized electrification for minimal risks and optimized operations

While the condition of each component is now available to operators at device level, the data still needs to be organized, visualized, and transformed into insights to give facility managers a holistic view up to site level. Leveraging one-stop cloud solution like SiePower, facility managers are now able to manage their power assets on across multiple sites in real-time. Powered by SENTRON technology, the digitalized experience also enables users to monitor their assets via a cloud-based platform. Along with a user-centric dashboard, insights such as power consumption, busbar temperature and health index are readily available, ensuring transparency across the entire LV distribution system 24/7.





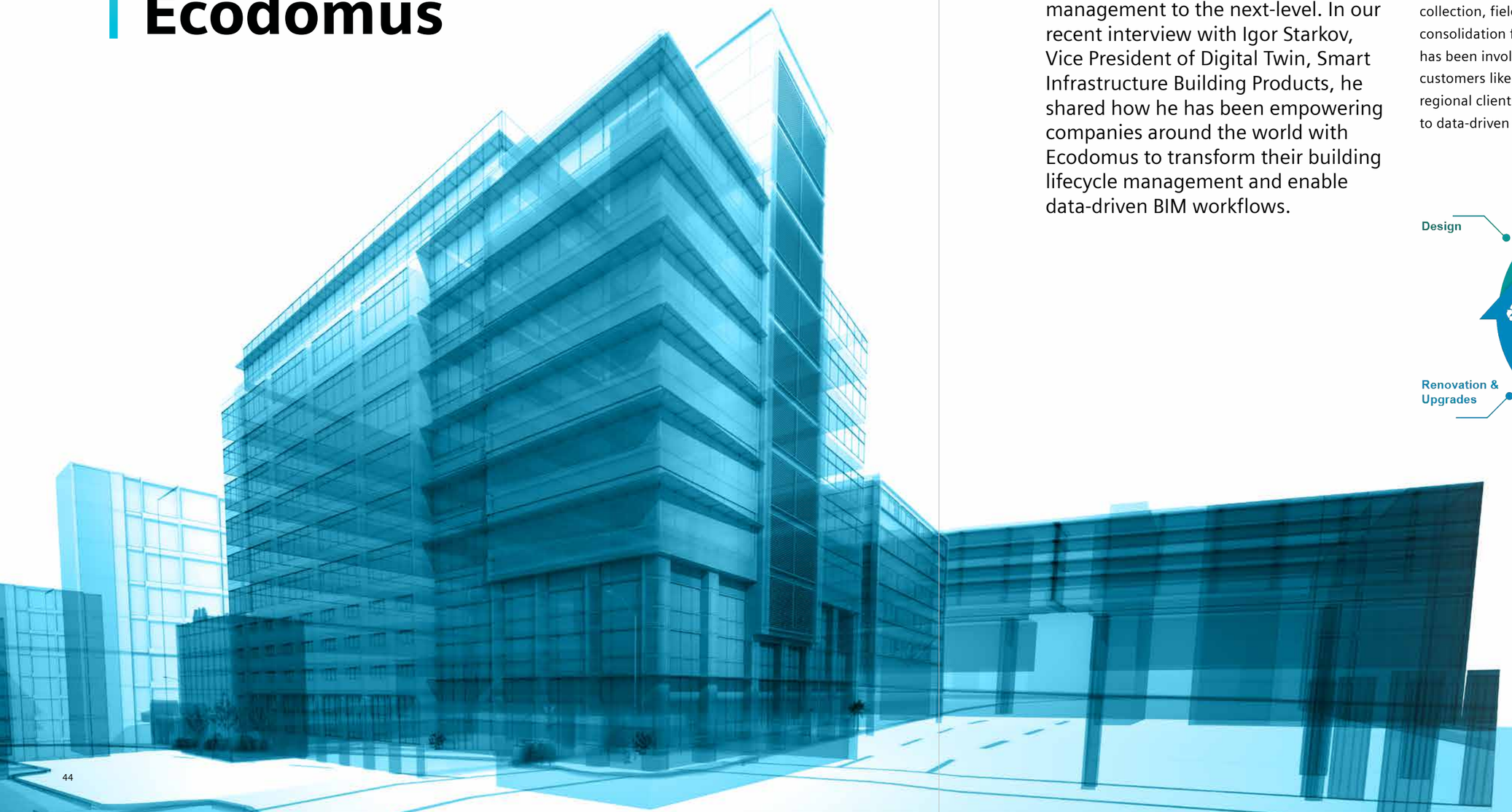
Ensuring maximum flexibility, data can be collected from either Siemens or third party circuit breakers and meters. Data are then transferred through secure and transparent network access via Modbus TCP and RTU to upstream SICAM A8000 IoT gateway and central data concentrator. Eventually SICAM A8000 IoT gateway transmits the data centrally to SiePower via cloud protocol such as OPC, OPC UA Pub/Sub, MQTT for further analytics and data visualization.

Leveraging integrated cloud solution like SiePower, intelligence can be extended all the way to the final subcircuits and enable comprehensive power monitoring. Empowering the operator to be always informed with a holistic picture in which not only an individual component, but also the maintenance status of the entire power distribution system. The combination of the health indicators and the remaining lifetime prognoses for all devices of a system yields the following benefits:

1. The maintenance status of the system can be quickly surveyed, components in critical condition can be identified and replaced, and the system availability can therefore be enhanced.
2. Maintenance activities can be planned well in advance, and personnel and material can be made available with pinpoint accuracy. This leads to streamlined system availability at reduced costs.
3. Last but not least, a transparent maintenance requirement provides operators with the certainty that spontaneous failures caused by components that are maintained too late become a thing of the past and do not further impair system availability.

In this age of disruption, data are more important than ever to empower facility managers to be well-prepared for unforeseeable challenges ahead. Through digitalizing the low-voltage power distribution, it creates momentum to shift the traditional reactive maintenance approach to predictive maintenance. Enabling a streamlined operation and making sure maintenance schedule hit the perfect window based on equipment condition and eventually, further enhance the reliability of power transmission by minimizing unplanned downtime.

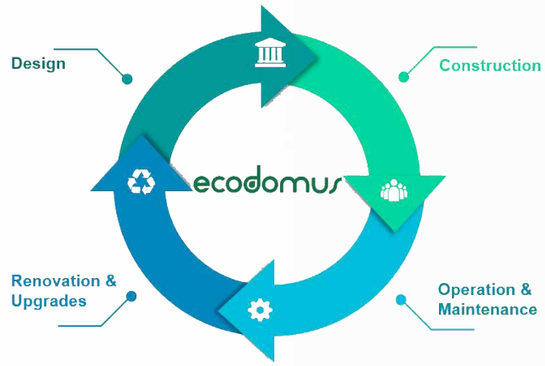
Transforming building lifecycle management with **Ecodomus**



As technology continues to evolve, the ability to efficiently maintain data along the building lifecycle is important to building owners and occupiers to operate and manage their buildings. With the goal to provide a more comprehensive digital building portfolio, Siemens has recently acquired digital twin software Ecodomus to take building management to the next-level. In our recent interview with Igor Starkov, Vice President of Digital Twin, Smart Infrastructure Building Products, he shared how he has been empowering companies around the world with Ecodomus to transform their building lifecycle management and enable data-driven BIM workflows.

What is Ecodomus?

Ecodomus is a software application that acts as a Common Data Environment (CDE) to integrate BIM, Building Management Systems (BMS), Computerized Maintenance Management Systems (CMMS) and Internet of Things (IoT) systems and helps create Digital Twin of facilities and infrastructures. While BIM data is used mostly during the construction phase, Ecodomus is able to extend the benefits of BIM data usage into design, operations and maintenance phase and facilitates data quality checking, documents collection, field results inspections and info consolidation for handover. In Hong Kong, Ecodomus has been involved in the BIM market for years with customers like Veolia, MTR and ArchSD, helping our regional clients transition from generic 3D modeling to data-driven BIM workflows.



Igor Starkov, an expert in construction process management software solutions, has been supporting companies in Hong Kong as well as other regions to transform their building lifecycle management and enable data-driven BIM workflows.

What are the challenges that CDE like Ecodomus is addressing?
The biggest challenge to many building owners is that the baseline data or information is not maintained in a systematic and structured way. A typical design or construction project generates a huge amount of data – even a small project like retrofitting requires the creation and sharing of untold data across the entire project lifecycle. Unfortunately, many companies struggle to manage information effectively. The collection of non-integrated info in form of Excel, PDF, BIM, and CAD, may lead to errors, reworking, or extra efforts to sort them out. Despite having thousands of sensors installed, without the high-quality operational baseline data collected via Ecodomus, project managers will need to spend more time commissioning and delivering new facilities while facility managers will also face greater hurdles on operation optimization.

How does Ecodomus help customers to address these challenges?
Ecodomus CDE operates as a single source of truth platform where all the information like asset properties, documentation, graphical models, and time-series data from sensors is gathered in the same database. By generating digital replicas of real buildings and assets, it allows customers to compare ideal or simulated data with the actual data from sensors efficiently and accurately. Such a well-executed CDE system benefits the workflows of anyone who is involved.

How has the COVID-19 pandemic affected the implementation?
Ecodomus allows project managers to construct and maintain buildings in a safer and smarter ways during the pandemic. By providing a CDE platform where facility information can be housed, consolidated, and controlled remotely, projects can be carried out in the virtual realm. Furthermore, with the COVID-19 pandemic serving as a catalyst, more people realize the values brought by controlling buildings remotely using digital twin – better monitoring using IoT and big data with enhanced efficiency leveraging AI-enabled analysis.

What do you think BIM-based software will be like in the future?
BIM-based software like Ecodomus is now shaping a more integrated environment that enables database-driven analytics, augmented reality, and machine learning. By unleashing a data-driven decision process, it will unlock the efficiency potential on all sides of the operations and ensure data consistency and uniformity across the entire building lifecycle.

Ecodomus supports multiple rendering quality options, merging of 3D parametric models (produced from BIM) with point clouds and CityGML files within the same scene.

Get more information

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