INDUSTRY INSIGHT

buildingSMART International

Electrifying openBIM

How the Electrical Domain at buildingSMART International is transforming the building landscape

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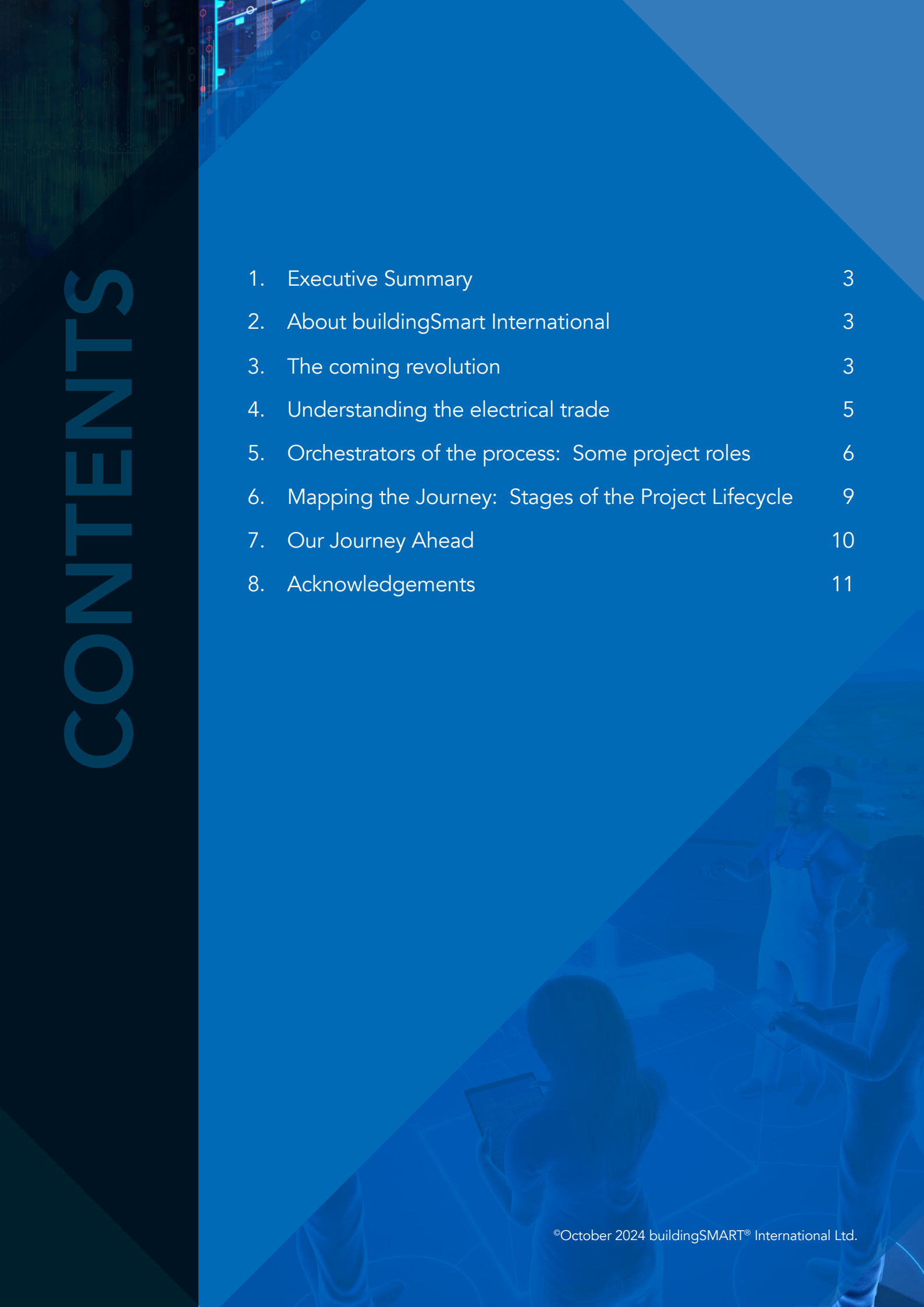


1. Executive Summary

We are the "Electrical Domain". We are a team of innovators, eagerly embracing the digital revolution. Our special focus is low- and medium-voltage power distribution within buildings. We address the entire lifecycle, from planning through construction and operation to demolition.

We've brought together professionals with a passion for efficiency and a vision of using Building Information Modeling (BIM) precisely for this purpose. We're making a difference by focusing on electrical systems and how they intersect with architectural design.

Our mission is simple – enhance building performance by integrating the power of electrical systems into the very fabric of building design. And how do we achieve this? By properly using openBIM standards, the Industry Foundation Classes (IFC) and restructuring the way we approach building design and operation.

To guide our journey and validate our approaches, we lean on relevant use cases that reveal practical insights. These cases highlight both challenges and solutions to align our strategies with real-world scenarios.

2. About bSI

We operate as the Electrical Domain under governance of buildingSMART International (bSI). bSI is the worldwide authority driving the digital transformation of the built environment, through creation and adoption of open, international standards for infrastructure and buildings. Through its community of experts and specialists, work is done in various Domains spanning different asset types, bSI helps to develop standards and services needed for an ever-changing and digital future so that the industry can be productive and sustainable.

3. A revolution incoming

We are on the cusp of a transformation that will revolutionize the way we plan, build, and operate our buildings. The future dynamics of infrastructure and building design are characterized by a shift towards a more data-driven and digitized approach. This evolution requires a focused response and an adaptive mindset, which is precisely what our "Electrical Domain" brings. The Domain is particularly focused on low- and medium-voltage power distribution in buildings. This is our specialty.

Imagine a transformation that is not made of physical materials like bricks, steel or glass but embedded in an elaborate system of circuits, wires and smart devices that bring buildings to life. This is our domain, and we are aiming to pioneer a way forward to benefit the industry,

Grounding our work in practical business scenarios, we are crafting use cases that will validate our work and conclusions. Every stride we make in Building Information Modelling (BIM) is calibrated to real-world examples, bridging the gap between abstract concepts and tangible benefits. Our approach ensures that our technological advances in BIM are always coupled with practical utility, fostering adaptability and responsiveness in rapidly changing environments. Therefore, we are setting up use cases that back up our exchange requirement proposals.

We have brought together a diverse group of professionals, including experts in low- to medium-voltage electrical solutions, innovative software developers, and skilled electrical engineers, alongside building operators and contractors. United by a common vision, we recognize the transformative potential of digital tools, particularly BIM, to enhance building efficiency, sustainability, and adaptability in this fast-evolving era.

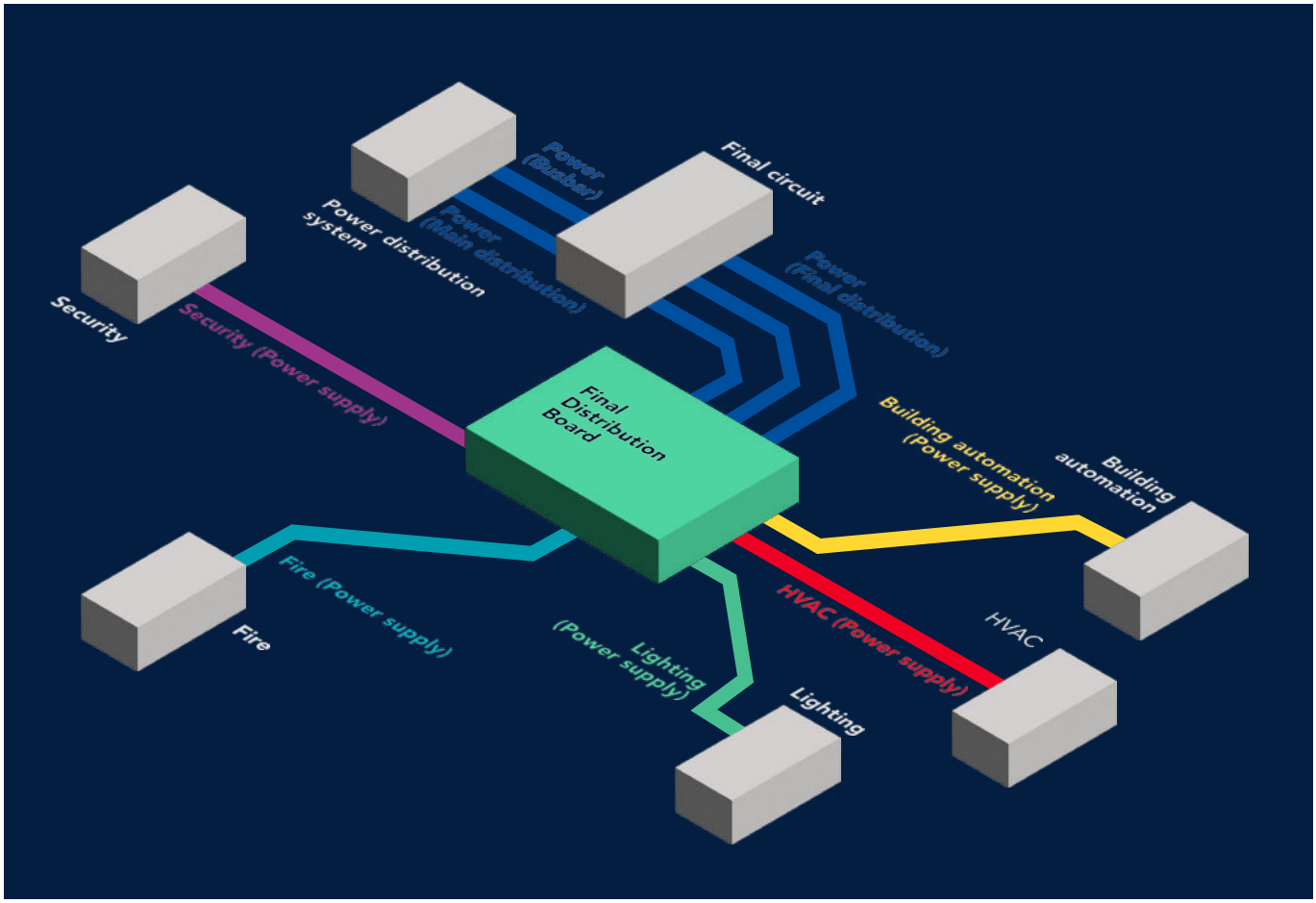
Our mission is unique. We're redefining the interaction between architectural design and electrical functionality, focusing on aspects of power distribution to ensure optimal building performance.

We're putting a spotlight on the often-underestimated electrical systems within the model of a building. Because these systems form the backbone of any modern structure, providing power and ensuring the smooth operation of a building's vital functions.

As such, understanding their impact is crucial. One of our most important tasks is properly integrating electrical systems within the openBIM workflows, which includes the Industry Foundation Classes (IFC). By restructuring or integrating electrical system data into the IFC, we'll enhance the accuracy and usability of this information, enabling better engineering design and operation. We also believe this will have far-reaching benefits for the industry.

Our journey is all about innovation, rewriting the rules when necessary, and pioneering new approaches.

Everyone in the "Electrical Domain" has a role to play in this transformation. We are embracing this change together, shaping a future marked by the ability to finally collaborate on an open standard within the electrical trades and connect to the related trades.



4. Understanding the electrical trade

Imagine a modern building as a living organism, as dynamic and pulsating as the world around it. Its heart, the electrical system, circulates power throughout the structure, supplying life to every corner. Whether it's lights that illuminate the workspace, the cool caress of the air conditioning on a hot day, or the elevators carrying people up and down with ease, each relies on a network of electrical systems. They are the veins of any modern building and form the foundation for the simple comforts and crucial services we often take for granted.

The architects of this advanced system are professionals in the electrical trade, specializing in low- to medium-voltage power distribution systems and incorporated devices. They are the builders of this complex web, ensuring the electricity reaches exactly where and when it is needed, operating safely and efficiently under careful supervision.

The design, installation, operation, and maintenance of these systems require a sophisticated combination of technical and practical skills, deep understanding, and application of science and mathematics.

With the advent of BIM, the electrical trades have transformed the way we design and manage buildings. This digital realm integrates the building's electrical systems into virtual models, allowing potential design conflicts to be identified early on.

Integrating electrical systems into digital models of buildings will lead to increased efficiency and a more sustainable future. It will facilitate early detection of potential conflicts in the design phase, thereby reducing costly modifications during construction. Also, it will streamline operation, maintenance, and upgrades throughout the building's lifecycle, making buildings more adaptable to the changing needs.

A building management system provides an oversight of the electrical systems, ensuring it's effectiveness and efficiency is monitored. By identifying potential issues early, it prevents them from becoming major headaches, saving time, effort, and reducing repair costs.

By using all the data the system collects, we can see patterns and predict when parts might need maintenance, stopping problems in their tracks. This strategy not only saves time but also prevents needless maintenance. The building management system also covers regular checks and reports. It's like having a tireless assistant working around the clock.

And when it's time for upgrades or changes, having a digital twin of the building is like a rehearsal before the big show. We can virtually test changes and iron out mistakes before they're actually implemented.

Let's delve into the technical symphony of the Electrical Network. It is a well-orchestrated system that unites diverse elements for optimal building operation.

First in line are the power sources, from the incoming medium voltage (MV) supply to sustainable options like on-site photovoltaic or wind energy, transformers, and energy storage solutions like batteries. These are not just components, but the lifeblood of the network, supplying the power that drives everything else.

Next, we have the Uninterruptible Power Supply (UPS). It's the network's safety net, ensuring continuity of power in the face of fluctuations or failures in the primary sources.

The distribution equipment, including switchboards and boards, performs the critical role of directing power from the sources to the loads. These are the traffic controllers of the electrical network.

We find protection, switching, measuring and monitoring devices housed within the switchboards and distribution boards. These devices are essential for protecting and controlling the electrical equipment, managing power flow and ensuring safety.

Power then travels through the transportation equipment, such as busbars and cables. These form the infrastructure that physically connects the sources, switchgear, and loads.

Then we reach the loads – HVAC boilers and chillers, lighting systems, building automation systems, and specific loads. These are the consumers, each performing a distinct function that contributes to the overall operation and comfort of the building.

Next are the building control and power management and monitoring systems. They serve as the network's nerve centre, continuously monitoring and controlling the different elements to ensure efficient operation.

Finally, the building management system is at the top of the hierarchy. It provides centralized control over the power network, integrating the various systems and processes for optimal performance.

Each component of the electrical network plays a vital role, working in harmony to ensure the efficient and reliable operation of our buildings. This complex, interconnected system showcases the sophistication of modern electrical engineering and building design.

With the ever-evolving landscape of electrical infrastructure in mind, it becomes crucial to understand how this complex network functions through different stages. From planning to demolition, each phase presents its own set of unique challenges and opportunities.

Now we dive deeper into this technical environment, exploring the stories of the people, their roles and contributions that shape the electrical trade.

5. Orchestrators of the process: Some project roles

We would now like to compare the roles of a construction project to a living organism, each playing a unique role in ensuring its survival, growth and overall well-being. Architects, planners, experts, contractors, suppliers, and operators represent distinct elements, each contributing different yet interconnected functions much like cells within a body. However, their roles aren't isolated or strictly sequential. Cells don't operate independently – they work together in unity for the entire body. They each have a role, and much like in a construction project, changes can have big a big impact on other important phases of the project.

Just as a change in one cell type can affect the entire organism, a shift in a later phase of the project can trigger changes in the earlier ones, disrupting the process. This can affect schedules, budgets, quality and delivery of a project and can lead to waste and poor productivity.

If we use this analogy for the future, our organism is evolving. Cellular changes happen, as do changes in projects. This is a symptom of modern construction, where the collaborative synergy of our 'cells' ensures our buildings are not only efficient and effective, but also adaptable to a future-looking state.

Let's now take a closer look at these 'cells' of our construction organism, their distinct functions, and how they contribute to the successful creation and maintenance of our 'living' buildings.

Investor:

The investor is the project's financial powerhouse, providing the critical funding for the construction engine. This role is not merely about disbursing funds; it involves judicious decision-making about budgeting and project profitability. In tune with the project's rhythm, they coordinate with other stakeholders to align financial objectives, ensuring the project stays on track financially.

Architect:

As the artists of the building industry, architects use their creative and technical expertise to design structures that are aesthetically pleasing, functional, safe, and in harmony with the environment. They contribute to the BIM model by adding data on the space requirements and technical capabilities of the electrical systems. This is the fundamental layer that the rest of the project builds upon.

Electrical Planner:

Like the chess players of building design, electrical planners follow by considering the architectural design details and strategising and planning the electrical layout of a structure. They ensure that power reaches every necessary point efficiently and safely, which is crucial in making a building functional and comfortable. With detailed information about constraints, decentralised power production, energy storage and electrical load requirements, they weave an efficient and reliable electrical layout into the architectural design, enriching the BIM model with this invaluable data.

EPC/GC (Engineering, Purchase, and Construction / General Contractor):

The EPC/GC is like the 'ringmaster' of the construction circus, managing the show from start to finish. Their job is to ensure everything is in perfect harmony. They coordinate the amazing acts, from the high-flying non-electrical contractors to the diligent electrical planners and panel builders, ensuring each performer sticks to the script – meeting technical standards and regulations. The 'ringmaster' closely monitors the time, cost, and quality of the performance, communicating with all the performers to ensure a smooth show. Their ultimate goal?
To ensure the construction project becomes a grand spectacle, earning a standing ovation from all stakeholders.

eEPC (electrical Engineering, Purchase, and Construction):

As the project's electrical contractor, this role orchestrates all things electric – from engineering to installation. It's like a master juggler, managing various tasks, from coordinating with others like planners and panel builders to ensuring all regulations are met. Above all, this role keeps the project's electrical rhythm in line, ensuring all tasks are performed on time, within budget, and to the highest standards.

Panel Builder:

Panel Builders are responsible for the construction of power distribution boards and distribution boards. These panels are the heartbeat of most manufacturing, industrial, and domestic electrical installations, dictating electricity distribution throughout a building. The panel builders' core business is a complex and meticulous process. It involves designing a logical layout for ease of maintenance, diagnostic testing, and part replacement, and then preparing the panel and anticipating all components in their designated positions.

After refining and getting the layout approved, the physical construction of the panel starts. The panel builders' finished products, therefore, are more than just components; they are the nerve centres of electrical safety and efficiency in a building.

Installer:

Installers are the hands-on professionals who put the plans to life by arranging the components of a complex mosaic. They're responsible for the physical installation of the electrical systems within the building, ensuring everything is set up correctly and safely. Their craft is vital for transforming the architects' visions and electrical planners' designs into tangible reality.

System Integrator:

System Integrators serve a critical function in making all the different parts of the electrical system work together seamlessly. They take various technologies and components and ensure that disparate technologies work together, creating a seamless and efficient whole.

Operator:

Like the building's vigilant nervous system, operators are more than just overseers. They play a crucial role in managing the building's systems, using detailed data from the BIM model. They handle preventive and corrective maintenance, adapt the systems to evolving needs, and ensure the electrical systems' continued efficiency and safety. Their work ensures the continued efficiency and safety of the building's electrical environment.

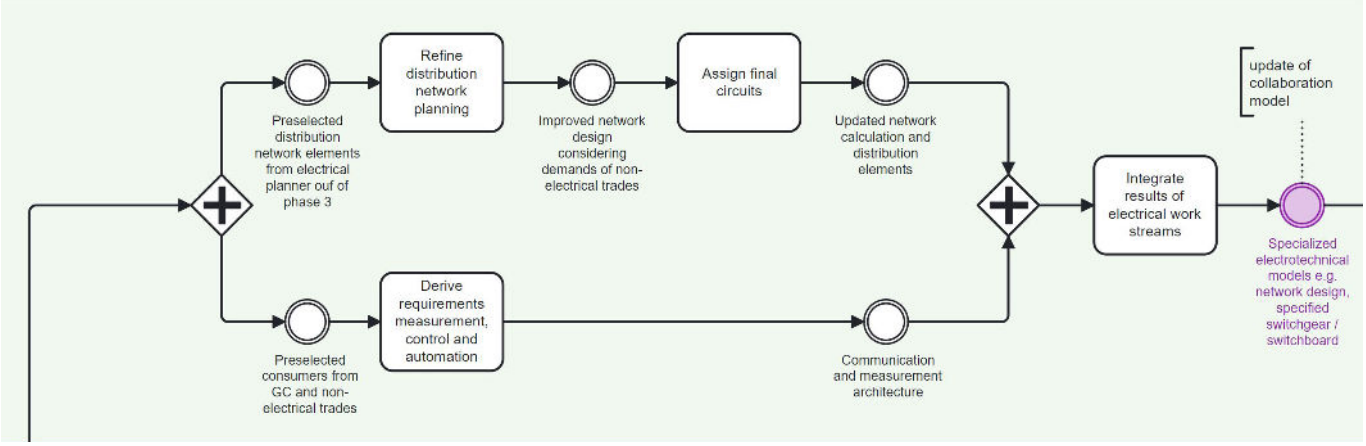
Service Provider:

Acting as the guardians of the building's electrical systems, Service Providers handle the upkeep long after the construction has been completed. Their tasks range from replacing electrical components to ensuring the building meets evolving regulations. They also harness digital twin technology to mirror the physical building in a digital space, allowing them to identify issues and conduct maintenance remotely.

Group Demolition Contractor:

With a deep sense of responsibility, Demolition Contractors navigate the complex end-of-life phase of a building. Their task is far from simply tearing down structures. They carefully plan and execute the process to ensure maximum efficiency, while complying with strict sustainability regulations. They are experts at resource management, salvaging and recycling materials wherever possible to reduce the environmental impact. Using modern tools and techniques, they safely and responsibly dismantle electrical systems, preparing the site for new construction while conscientiously managing the use of materials and resources.

In the journey of an electrical network within a building, roles and responsibilities transition with every lifecycle phase, from design to decommissioning. The expertise of the professionals mentioned drives this progression. Now, let's explore each phase's specific challenges and opportunities and the contribution these professionals make.



6. Mapping the Journey: Stages of the Project Lifecycle

We started with the Business Process Model and Notation (BPMN) diagram to orchestrate this symphony. In it, we outline the entire process chain and create clarity about the roles and responsibilities of the individual parties involved.

Planning:

This is where the vision takes shape. Experts such as electrical engineers, architects, and MEPs (Mechanical, Electrical, and Plumbing) collaborate, using Building Information Modeling (BIM) tools to design and simulate electrical systems. They consider power sources, load requirements, and energy efficiency, preparing a comprehensive blueprint that balances functionality, safety, and sustainability. In this stage, they anticipate potential challenges, like system conflicts or construction issues, to save resources and time.

The architect sets the vision. Using their deep understanding of power distribution, the electrical planner devises an electrical layout that aligns with the architect's design. Advanced tools are used to create detailed information from phase to phase, develop models of the building and its tenders, and allow for thorough visualization and testing. The models can be descriptions, diagrams, 2D or 3D data. Contractors provide and check information on available materials and technologies that could be integrated into the design. If there's a need to revise certain decisions or details, everyone returns to the drawing board, adjusting their plans accordingly.

Construction:

Here's where the plans turn into reality. The construction team, armed with detailed designs, installs the electrical network - from power sources and distribution equipment to cables and control systems. Specialized experts ensure that every switch, wire, and circuit complies with safety standards and project specifications. In essence, this phase is all about building the physical structure, from the backbone to the intricate web of the electrical network.

EPCs take the lead, transforming digital plans into physical reality. They coordinate with all trades, including the electrical engineering experts who oversee the implementation of the electrical systems. Suppliers ensure the timely provision of required resources. If issues or conflicts arise during construction, a collaborative revision of the plans might be necessary, with adjustments made in the BIM model and communicated across all roles.

Operation:

This is when the system comes to life and serves its purpose. The electrical network powers the building with a vast number of different electrical consumers, from lighting and HVAC to security and automation systems. The Building Management System continuously monitors and controls these operations, ensuring the smooth functioning of the systems. During this phase, building operators and maintenance personnel also leverage the information from the BIM coordination model, monitoring system performance, carrying out preventive maintenance, and troubleshooting any issues.

Once the building is complete, the building operators take charge, ensuring everything runs smoothly. They rely heavily on the Building Information Model and the electrical plans provided by the electrical planners to guide their maintenance tasks. Therefore, the BMS provides tools for managing and monitoring the building's performance, including the electrical systems. If performance issues arise, these might require revisiting the plans and possibly revising the construction or design.

Demolition:

This is the stage where the sun sets on the building's journey. The demolition phase involves safely decommissioning and dismantling the building and its electrical systems. This includes proper disposal or recycling of materials and responsible management of any waste. In some cases, certain parts of the electrical system may be reused or re-purposed in other projects. It's the final act, closing the curtain on the building's story while setting the stage for new beginnings.

When a building has reached the end of its useful life, all roles converge again. The BIM model provides a comprehensive overview of the building's construction and materials, which can guide safe and efficient demolition processes. If issues arise during this phase, everyone must look back to the planning phase to find practical solutions.

A BIM approach will transform the traditional siloed method into a more integrated and collaborative process. Now, all roles can interact, share information, and collaboratively solve issues using a shared digital model. This not only improves efficiency and outcomes but also fosters a sense of shared responsibility and cohesion among the team. It is a constant cycle of learning, adapting, and optimizing, creating a dynamic environment where everyone and the project can flourish.

7. Our Journey Ahead

While each role operates independently, the evolution of Building Information Modeling (BIM) and Industry Foundation Classes (IFC) brings forth a collaborative approach where everyone's work is interdependent.

The current IFC standard primarily supports architectural and structural aspects of buildings but lacks comprehensive support for the electrical trade, especially for low- and medium-voltage power distribution systems within buildings. This limitation inhibits BIM's full potential of enhancing the efficiency, accuracy, and collaboration of electrical projects.

Therefore, a key solution is the expansion and refinement of the IFC standard to fully accommodate the unique workflows and data requirements of the electrical trade. This will allow for the creation of more comprehensive use cases that reflect the full spectrum of interactions and data exchanges among all involved parties.

In essence, the "Electrical Domain" group's mission is to drive this change to unlock new possibilities for collaboration, efficiency, and innovation within the electrical trade.

If you are inspired by this, and want to join in, we recommend you contact us at contact@buildingsmart.org for more information.

Visit: https://www.buildingsmart.org/standards/domains/electrical/

8. Acknowledgements/Editor

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