CREATING THE DIGITAL THREAD IN TRANSMISSION & DISTRIBUTION

How BIM & PLM are Ready to Digitize Electrical Transmission and Distribution Infrastructure Information Management

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EXECUTIVE SUMMARY

The opportunity on offer

In industries such as high-tech manufacturing, construction and facilities management, digital tools are now widely used that enable end-to-end collaboration and control throughout the asset lifecycle, from design through construction to operation. The advanced design and collaboration capabilities available are also highly applicable in the utilities industry—yet to date, most utilities have been relatively slow to develop or adopt them. Forward-thinking utilities have a major opportunity to extend their leadership in the industry by investing in these areas.

Two tools are at the core of this opportunity: Building Information Model (BIM) and Product Lifecycle Management (PLM). By adopting, implementing and fine-tuning these technologies, utilities can execute complex projects or programs at higher quality and lower cost, improve labor productivity, stay relevant to their increasingly technology-savvy workforces, and manage regulatory compliance more easily in an ever more challenging operating environment.

The complementary strengths of BIM and PLM mean deploying them together is the optimal approach. While this inevitably involves overcoming some challenges, proven approaches are available to help companies progress along the journey. What’s more, the integrated data pipeline created and driven by BIM and PLM can enable powerful capabilities in the operations and maintenance phase - namely the digital twin and the digitally-connected worker.

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As the need for collaboration has grown, utilities have taken steps to improve their collaboration technology. However, for the past few decades the progress has tended to be incremental and siloed rather than rapid and enterprise-wide. Improvements in the capabilities of design authoring tools such as Powerline Systems’ PLS-CADD, AutoCAD Inventor and ESRI ArcGIS have enhanced their capabilities and enabled efficiencies, but primarily only within functional siloes. More advanced document and file management technologies have also been deployed, but at varying levels of effectiveness. More recently, the expanding use of field applications and tablet computers has offered the ability to use digital drawings, but access to drawings has not been consistently integrated into project management or design workflows. Finally, maintenance functions have started using enterprise asset management systems like Maximo or Infor, but the tools have been poorly integrated to design and construction, resulting in improved financial reporting capabilities, but limited productivity gains.

Largely as a result, design models and design data have remained mostly stranded in silos and have not been able to reach their full potential as data-rich interactive resources. Also, the people executing projects have spent a growing proportion of their time managing interfaces between poorly-integrated tools and other functional groups or vendor partners. Identifying and managing the standards and requirements appropriate to a project are also difficult. Against this background, the primary challenge in today’s utility projects is now coordinating processes to meet budgetary and timeline constraints—with labor-intensive email chains, spreadsheets, file-share sites and status update forms often taking up as much time as key tasks like preparing designs, shipping materials and building assets.
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What’s needed to break out of this logjam is collaborative project delivery, based on a set of coherent and connected technology-enabled business processes working in an integrated fashion, representing all project participants. To deliver the fullest possible benefits, this environment should include design authoring tools, mobile field worker tools, project management and controls tools, asset management tools, and supply chain tools. The place to start is with BIM and PLM.
BUILDING INFORMATION MODEL (BIM)

BIM’s origins and evolution

The concept of Building Information Modeling (BIM) has been pioneered in the buildings and facilities management industry, though similar concepts have developed in other industries, such as ISO 15926 in oil & gas. The bedrock of BIM is design authoring capabilities that facilitate collaborative workflows, combined with some limited project management tools and digital worker solutions. By integrating these tools through a collaborative design environment, companies can create connected workflows between project participants, better designs, and more informed project management. At the end of the project, these models can then be turned over to the owner to support asset/facility management, although owners’ ability to use the models varies widely.

The fundamental capability at the heart of BIM is 3D digital modeling, supplemented by supporting data about components of the 3D model. As this data becomes more integrated, accessible and clearly-defined, the maturity of BIM increases, enabling higher-level processes and inclusion of more project stakeholders and project delivery approaches. More advanced BIM capabilities and workflows often draw a distinction between authoring tools, analysis tools and the collaborative functions carried out in a common data environment. For example, the UK standard for BIM—BSI/PAS 1192:2—defines a common data environment as the single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multi-disciplinary teams in a managed process.

Adoption drivers for BIM

In terms of the benefits experienced by users of BIM, useful insights have been provided by McGraw Hill Construction in its report *The Business Value of BIM for Owners* which offers an overview of BIM and how it is delivering value. The report finds that most project owners highlight multiple cross-cutting benefits from using BIM (see Figure 1).

Figure 1
Results from McGraw Hill Construction’s BIM study

Owners’ Ratings of BIM Benefit Statements
(Those With a High or Very High Level of Agreement)

<table>
<thead>
<tr>
<th>Benefit Statement</th>
<th>US Owners</th>
<th>UK Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIM Visualization Enables a Better Understanding of the Proposed Design</td>
<td>66%</td>
<td>98%</td>
</tr>
<tr>
<td>There Are Fewer Problems During Construction Related to Design Errors, Coordination Issues or Construction Errors</td>
<td>53%</td>
<td>85%</td>
</tr>
<tr>
<td>BIM Analysis and Simulation Capabilities Produce a More Well-Reasoned Design</td>
<td>50%</td>
<td>92%</td>
</tr>
<tr>
<td>The Use of BIM Generates a Beneficial Impact on Project Schedule</td>
<td>49%</td>
<td>85%</td>
</tr>
<tr>
<td>The Use of BIM Generates a Beneficial Impact on Control of Construction Costs</td>
<td>44%</td>
<td>72%</td>
</tr>
</tbody>
</table>

Source: McGraw Hill Construction

In light of such benefits, governments around the world are starting to require usage of BIM in publicly-funded projects to ensure lower lifecycle costs for the entities owning them. The UK government has mandated that the use of BIM be phased into government-funded projects consistent with its maturity model, BSI/PAS 1192-2. In the US, the National Institute of Building Sciences’ “buildingSMART alliance” has collaborated on standards for BIM, but these have not become part of an overall government mandate.
To date, the utilities industry has yet to develop an industry-wide standard or approach for BIM, a factor that has hindered deployment efforts. A further issue hampering BIM adoption is that utilities—like other industries such as oil & gas and manufacturing—have their own industry-specific vocabulary, which is different from that used in the architecture, engineering and construction (AEC) industry where many BIM tools were pioneered.

However, despite the limited adoption, there is a strong case for BIM in utilities. Like AEC, utilities utilize a complex network of consultants, vendors and contractors, all needing simultaneous access to project data and 3D model data. Managing this ecosystem is a complex and challenging task, yet many utilities still handle it in the same way they did 30 years ago. Most distribution line design is still done in 2D, as is most substation design. And while most transmission line design is done in 3D, there is limited collaboration around the 3D model outside of the engineering silo.

In adopting BIM tools, utilities are hardly moving into an unknown territory. The BIM authoring software market includes many tools familiar to utilities such as AutoCAD, Bentley Substation, Autodesk Inventor, Civil3D, PLS-CADD, and more. BIM authoring tools like these can fuel a collaborative environment where project stakeholders make use of the data seamlessly across functional and company borders. Available capabilities include using authoring tools to pull data from the collaborative environment to carry out specific analyses, as well as separate analysis tools that can leverage data from the collaborative BIM environment to undertake higher-order analyses and visualization tasks.

Unfortunately, most utilities do not use the existing tools as part of an intentionally-created, end-to-end information management system. However, the tools can be integrated together to create a seamless end-to-end environment – and a generic system map for integrating the BIM and PLM capabilities described in this paper is shown in Figure 2. Higher-level analyses that might be implemented to help manage the system include clash detection between different independent design disciplines, coordination between different organizations (owners, consultants, vendors and so on), and simulation/visualization of project features relative to a construction schedule.
Defining PLM—and the benefits it offers

Gartner defines Product Lifecycle Management (PLM) as “a philosophy, process and discipline supported by software for managing products through the stages of their life cycles, from concept through retirement. As a discipline, it has grown from a mechanical design and engineering focus to being applied to many different vertical-industry product development challenges.”

In practice, this definition means PLM has a wide range of valuable uses in many different industries. For example, it can manage things like an approved manufacturer list or approved supplier list. Bills of material for designs can be managed in PLM, as can standard designs for complete substations or substation components, and any quality issues with parts or complete designs. By doing all this in PLM, companies can manage design data across their systems in one centrally located place with one set of policies, avoiding the long cycle times and ambiguities in processes and decision-making that result from carrying out these tasks in ad hoc or manual ways. PLM also enables an organization to ensure that its products and suppliers are of appropriate quality, that poor performance is acted upon, and that opportunities for savings are understood and realized. With PLM, these aspirations start to become real capabilities, leading to accelerated process improvement and enhanced regulatory and procedural compliance.

PLM technology has been pioneered in manufacturing—specifically the high-tech end of the manufacturing sector—where managing complex supply chains and design processes with extreme speed and efficiency is paramount. Experience has demonstrated consistently that the returns on investments in PLM are significant, with PLM implementations in manufacturing having been shown to reduce material costs by 5% to 15% and operational & development/engineering expense by between 1% and 30%. Cycle times for change control can be reduced by 10% to 75% and design cycle times by 5% to 35%.
There’s every reason to believe that the benefits PLM offers to utilities can be every bit as large as those already being experienced in high-tech manufacturers. Utilities and manufacturers share similar capability needs in the design and operation of T&D assets: while the result for a utility is a fixed asset in the field, the requirements in terms of capabilities mirror the drivers for adoption of PLM in manufacturing. Utilities build assets utilizing standard parts and components that have been selected on the basis of decades of operational experience, standardized techniques for maintenance and system/grid operations, and established procurement/sourcing relationships. Utilities are also focused on developing reusable designs and design standards, sourcing the parts for those designs from pre-approved suppliers at negotiated prices, building them repetitively, tracking variations in those designs, and maintaining the end-assets in the field indefinitely. The parallels with manufacturing are clear.

What PLM delivers for utilities

On their own, both BIM and PLM offer significant potential benefits to any utilities that have not yet adopted them. But integrating them together multiplies the benefits, creating a transformational solution that acts as the core of end-of-end collaborative project delivery and asset management. PLM can manage the standard parts, assemblies, component designs, complete template designs and final full designs of actual constructed assets. Meanwhile, BIM can serve as the environment of authoring tools, analysis tools, visualization tools, and coordination tools—including design, project management and construction—for in-process projects. The BIM environment can also host project design, utilizing standard designs from PLM and customizing them as needed. At key project milestones, BIM can publish the configured design to PLM, enabling rigorous change control and connecting to systems including project management, supply chain and asset management. Again, Figure 2 shows the integrated environment.

Why adopt BIM and PLM together?

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Figure 2
Generic BIM & PLM System Map
Key considerations when adopting BIM and PLM

For any utility—indeed any organization in any sector—looking to shift from existing work practices and tools to adopt BIM and PLM, it’s vital to consider the impacts and implications around two main areas.

**Process and people**

We know from experience that the pressure of maintaining everyday business-as-usual has seen many utilities evolve business processes that rely on organizational “dark matter”: processes that people carry out, but no one else understands them or knows is required. In cases where this type of problem has emerged, it’s imperative to gain an accurate understanding of the existing processes in order to assess the extent of the changes needed to processes and roles across functions and stakeholders. Additionally, there may be a need to address gaps in processes before moving forward with implementing more advanced technologies. Given that business processes are key in technology selection and system design, clear process definition and organizational alignment are critical to ensure that the right technology is chosen, and also to inform the creation of appropriate change management and training plan.

Turning to people issues, the fact is that legacy systems and processes create change management challenges for every utility. Successfully deploying new technology and integrating it with the legacy environment demand not just the right software, but also well-designed business processes and the embedding of new skills into the workforce. Juggling these priorities can be very challenging—particularly if project resources are also tasked with ongoing project work—and poses risks to both the change management and project execution efforts. To manage and minimize these risks while deploying a sustainable, transformed business capability, utilities should create a dedicated team that combines people with BIM/PLM expertise and change management skills.

**Technology**

The technology architecture defined for the utility’s new BIM/PLM environment should take into account its current software capabilities, vendor roadmaps, and the need to create and maintain a “digital thread” connecting the data all the way from the early design stages through to operations. Other considerations around the technical architecture include addressing how systems will be integrated, how master data will be managed, and whether the solution will be implemented on-premise or in the cloud. Carefully consideration of these issues up-front will help to ensure long-term flexibility and the ability to evolve as technology continues to advance.
CONCLUSION

Time to embark on the journey

In Accenture’s view, the future of collaborative design and construction is clear. BIM and PLM are enabling technologies that are readily available, and proven to support utilities’ business requirements today and into the future. Given the future pipeline of capital investments now being planned, utilities should take the opportunity now to invest in transforming how infrastructure is delivered and managed, and how collaboration within their ecosystems is carried out.

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BIM and PLM represent the solution at the core of this transformation. Together, they enable the efficiency and process improvement that utilities have been chasing for decades—and they deliver this with software that’s proven across other comparable industries. As a result, transformational organizational change can be undertaken successfully using tried-and-tested methodologies, creating the basis for digital twin and the digitally-connected worker capabilities.

Across the world, we’re seeing more and more forward-thinking utilities embark on their BIM and PLM journey. Isn’t it time you joined them?
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