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WHITE PAPER

Breaking Down the Barriers to More Collaborative Factory Projects

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Regardless of whether we are talking about business-to-business or business-to-consumer industries, customer expectations in terms of individualization, functionality, and sustainability of products and services are increasing enormously.

To cope with the accelerating pace and added complexity, many companies have already adapted the ways they design, develop, and engineer their products, thinking of them in life cycles and often adopting agile development methods, concurrent engineering, and systems engineering.

Surprisingly, factories are often still designed and built in a very traditional way, as is the handling of data during operation and maintenance—area by area, discipline by discipline, data silo by data silo.

Increasing customer expectations inevitably lead to smaller lot sizes and frequent changeovers, meaning adaptive and elastic manufacturing operations are more important than ever.

We believe that the steps already being taken in product design and engineering in terms of integration and collaboration are also leading the way for manufacturing operations. Domains such as factory infrastructure and building information need to be integrated with the production system data to unlock the full potential of a comprehensive digital twin of the factory. In addition, the reuse of data across the entire production life cycle is required, even if—or precisely because—different stakeholders are involved at different stages, to avoid redundancies and non-value-adding tasks.

Digitalization is enabling manufacturers to usher their factories into this new era. This research by Harvard Business Review Analytic Services provides some useful insights on the current state of the industry as well as some guidance on preparing for a successful future for your existing or planned manufacturing operations using integrated factory models. I encourage readers to consider the examples of the industry leaders featured in this report as they respond to changing market environments.

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Breaking Down the Barriers to More Collaborative Factory Projects

Change is constant for factories as new products, customer expectations, and competitive pressures force manufacturers to repeatedly rework their current operations through retrofits or greenfield construction. As they undertake these projects, traditional goals to come in on time and on budget are increasingly complicated by new objectives, from sustainability targets to more efficient use of labor to Industry 4.0 requirements.

The complexity of these projects is increasing, but the processes used to plan and manage factory projects have not evolved in lockstep. Factory projects involve a wide range of teams from within the manufacturer itself and across its array of design and construction partners, all focused on building planning, production engineering, and ongoing operations. Too often, these teams—and the tools and data they use to complete their work—operate more independently than collaboratively, leading to cost increases, budget overruns, and time delays.

"Construction and plant engineering are two separate worlds that have not really had to be well coordinated up to now," says Frank Breitenbach, who is a senior technical expert in planning methodology, smart factory, for EDAG Production Solutions, a Fulda, Germany-based engineering service provider to the automotive industry. "In order for these worlds to grow together efficiently, it almost requires a paradigm shift in most companies."

It will take a well-coordinated, multi-disciplinary approach to factory design and construction projects to close these gaps and ensure that building; operations; and mechanical, electrical, and plumbing project teams collaborate closely to minimize delays, costs, and miscommunications while maximizing project-related, operational, and long-term business goals. To get there, manufacturers and industrial construction firms are working to adopt new planning and workflow paradigms, make smarter use of data, and tap more

HIGHLIGHTS

More and more requests for proposals for factory construction projects **include expectations around sustainability, digitization, and the desire for smart factories** that support Industry 4.0 concepts.

Despite these evolving requirements, **the processes and workflows used to plan and implement a factory** new build or retrofit have not always kept pace.

Technology is proving the key enabler in helping manufacturers and their planning and production partners **break down silos in tools, data, and collaboration** in their quest for an ever-more-seamless and effective way of planning and constructing a factory.

collaborative workflow technologies that will impact the building long after construction is complete. If their vision is achieved, future factories will be far more mutable and resilient, able to adjust nimbly to market changes while minimizing their own maintenance costs and optimizing their utility.

"To have highly efficient factories, you need real-time data in order to make the right decisions within the right context," says Maximilian Viessmann, CEO of Viessmann Group, an Allendorf, Germany-based manufacturer of heating, cooling, and climate solutions. "We can extend our market position when we can act fast—for our partners and users. Industry 4.0 is the enabler of this speed, and consequently the enabler of our future."

New World, New Pressures

Factories have always had to evolve, adapting facilities, production lines, development processes, and operations to meet the demands of the day. Typical drivers of these new builds or retrofits include new product releases, the need to improve product quality or production efficiency, changes in demand, continuous improvement, or replacing equipment. Industry-specific trends may also be factors, such as the need for smaller lot sizes or derivatives of a base product, increased mass personalization, a shift from fossil fuel to more sustainable energy sources, or the need to accommodate material shortages, produce closer to the market, or minimize labor requirements in the face of shortages. According to McKinsey & Co.'s June 2020 study, "The Next Normal in Construction," 87% of respondents cite the scarcity of skilled labor as having the highest impact on the industry. But within 10 years, more than 75% believe sustainability, work site safety regulations, and more flexible and digitally efficient structures will impact the industry at scale. **FIGURE 1**

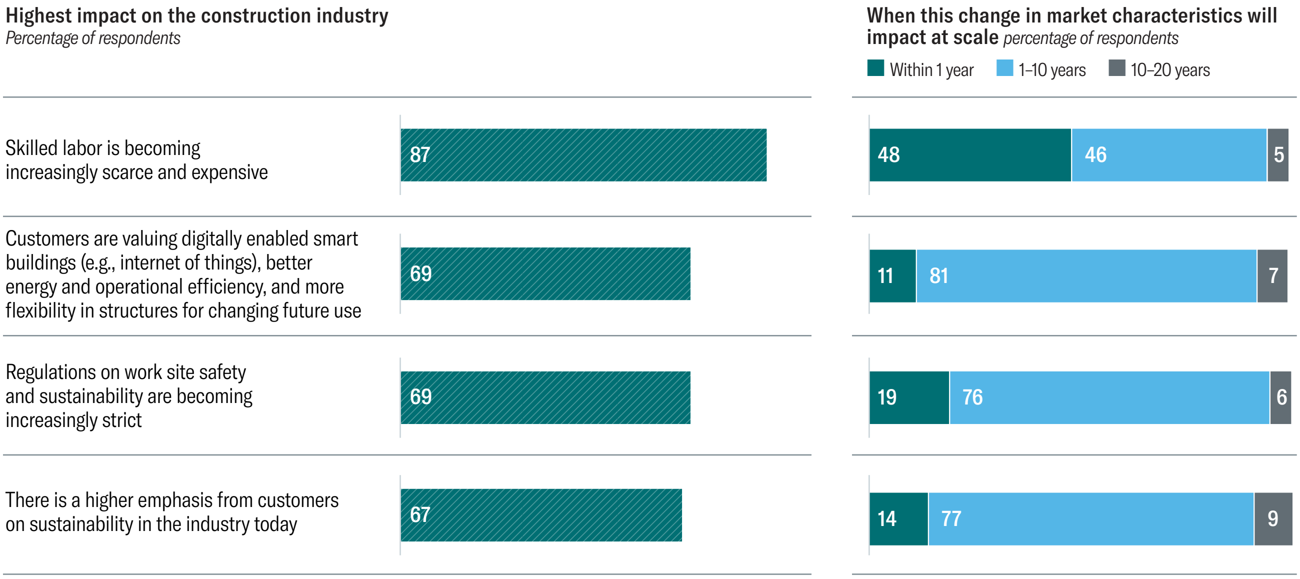
But alongside those drivers comes another set of requirements that are placing additional demands on design teams. More and more requests for proposals (RFPs) for factory construction projects include expectations around sustainability, digitization, and the desire for smart factories that support Industry 4.0 concepts. Manufacturers also want to complete projects faster than ever, particularly in retrofits; minimizing downtime and speeding time to market have become competitive necessities.

"Sustainability has taken much more center stage than it used to," says Rupert Hoecherl, managing director and partner at io-consultants, a management consulting firm in Bethlehem, Pa., whose projects include integrated consulting,

FIGURE 1

Market Factors Complicate Construction Projects

Scarce labor, smart buildings, and safety and sustainability regulations are top issues



Source: McKinsey & Co., June 2020

design, and planning services for production. “It was more of a voluntary approach in previous years. Now it’s becoming much more defined and institutionalized, and in some areas, it’s a regulatory requirement.”

A growing number of manufacturing firms are also citing a need for digitization, smart factories, or Industry 4.0 concepts. Customers come with varied definitions of what those terms mean, which must be ironed out in the initial project stages, says EDAG’s Breitenbach. Those Industry 4.0 requirements increasingly incorporate sustainability concerns, he adds.

“Industry 4.0 ultimately creates consistent horizontal and vertical networking within my production system and far beyond. This—and this is new in my view—has recently included the building. After all, it is the building that supplies my plant with space, volume, and operating materials. The building has to cope with my emissions, and in turn, it also provides environmental influences on my machines.”

The need for speed has been compounded by unexpected market and supply chain challenges, most recently with the pandemic. “We have seen extreme fluctuation during the pandemic allied with regional or international restrictions. This [fluctuation] has made it particularly difficult to identify the right time slot for pausing production for retrofit projects,” says Viessmann of Viessmann Group.

Gaps in the Factory Planning Process

Despite these evolving requirements, the processes and workflows used to plan and implement a factory new build or retrofit have not always kept pace. The fact is, a factory is by definition a complex system, one that is getting more so by the day thanks to advances in automation and technology. The confluence of rising complexity and disjointed workflows also makes coordinating its construction ever more difficult.

“The factory isn’t made up only of a building,” says Robert Ostermann, factory designer at Magna Steyr, an automobile manufacturer based in Graz, Austria. “There are a lot of conveyor systems, a lot of steel structure, machinery equipment, and so on. So a factory is more than a BIM [building information modeling] process, and to coordinate or maintain this entire digital spectrum is not a common process yet.”

Traditional approaches are often largely sequential, with one team completing work before handing off the work product to the next team. The data and tools they use are often also separate, requiring costly format conversions and a flurry of emails to manage changes and follow-ups. Communication gaps become inevitable, particularly in the handoff from one step to the next.

Reasons for the gap in communications vary. Small- to mid-size companies often go 10 to 15 years between new factory projects, so their planning processes may be out of date or nonexistent, says Matthias Dannapfel, chief engineer, factory planning, at RWTH Aachen University in Aachen, Germany. For enterprises, often they “struggle a little bit with how to put in the long-term requirements and how to translate those to factory structures. Because of the dynamic market environment, they have to throw the old assumptions overboard. They need to challenge the way they think and the way they envision the factories.”

> “What digital has done is enable people to replicate information, but it’s replication without management, meaning that they lose trust in the information,” says Brian Glancy, head of BIM strategy for Kingspan Group.

The issues aren’t just internal. Factory projects require coordination across internal and external teams, often divided between those working on the building itself and those focused on the processes and equipment that will go inside. Each typically brings their own tools and data stores to the task.

“Everybody uses different software tools where we do not have clear interfaces to be able to supply or to feed information from one to another,” says Dannapfel. “Therefore, we have a lot of losses of information while passing on manual rework or manual communication to make sure that all the information we want to try to bring over is broadcast to the next team and the teams that follow. This is a highly, highly inefficient process.”

“What we can do better is the communication on the process, the model coordination and how the factory design evolves,” adds Magna Steyr’s Ostermann. “The communication needs to take place directly on the model, not separated in different systems that do not communicate well.”

One approach to addressing communication hurdles has been to convert disparate data so it can be gathered in a single computer-aided design (CAD) environment, but this step is costly. Communications and change requests tend to occur outside this environment, leading to delays and errors, and changes to one system are not automatically available to others. Even efforts to practice simultaneous engineering of disparate planning processes get tripped up when communications break down.

While most factories have been largely digitized since the 1990s, much of the data has gone unused, and attempts to

> "Only interdisciplinary teams can manage the complexity and challenges of bringing all operational processes seamlessly together. Regular checks of the key figures for the whole value chain and frequent simulations of the processes ensure that we achieve the required metrics and meet our project goals," says Maximilian Viessmann, CEO of Viessmann Group.

create a single data standard among the tools used to plan, build, and maintain them have moved slowly.

"What digital has done is enable people to replicate information, but it's replication without management, meaning that they lose trust in the information," says Brian Glancy, head of BIM strategy for Kingspan Group, a building materials manufacturer in Kingscourt, Ireland. "That's why we try to ensure governance procedures around information."

In a familiar pattern, some tech companies generating design data as part of their toolsets have resisted attempts to create the open standards that other developers support. "I think this is one of the biggest problems. And this is one we have to solve when talking about a holistic view on the factory itself, and when we want to get all the benefits offered by BIM and the digital factory," says Breitenbach.

According to an academic paper produced by RWTH Aachen University titled "An Approach to the Analysis of Causes of Delays in Industrial Construction Projects through Planning and Statistical Computing," BIM is designed specifically to address the disconnects between the building planning and construction planning processes, but it is used far more in housing and public building construction than in factory planning. Research to support the paper found "scarce implementation in factory planning projects due to (1) missing maturity level specifications and (2) missing data management standards."

Not all the challenges are technical, says Breitenbach. Alongside the shift to more data sharing and the collaboration it enables, the varied teams must also commit to newer ways of working. "We need a meeting culture and a meeting structure in our projects, regular meetings, so people are driven to talk to each other and to exchange that information."

The Costs of Planning Gaps

Flaws in the factory planning and construction process are costing manufacturers across multiple dimensions that can impact not just the project itself but factory operations and maintenance over the long term.

"At the end of the day, the impacts are always somewhere between scope, time, and budgets," says io-consultants' Hoecherl. "If things get overlooked, if you need to make adjustments later in the project, it has an impact on the timeline, and most likely on the budget, as well. One reaction can be to rethink the scope in an effort to mitigate the impact. Significant misses or design flaws may inadvertently reduce the installed capacity and potentially limit the building's usability and longevity."

Trade-offs in the amount or type of equipment or technology a project was able to include can mean hiring more labor or losing out on technical benefits, he adds, but fortunately, the quality of the product itself is usually unaffected.

Other impacts may include supplier integration failure, the need to reengineer more often, and efficiency losses.

Even a successfully completed construction project, produced in traditional ways, falls short of where factory design is headed in terms of its impact on the ongoing life of the building. Without the benefit of newer concepts such as modeling, establishing a visual plan for how a factory and its production equipment will be created, and digital twins, creating an exact digital replica of a physical asset, it's more difficult to maintain a digital record of the decisions and details that went into design choices. The lack of data makes future modifications more costly and difficult.

The Integrated Factory Vision

The concept of a fully integrated factory design process is grounded in the vision for future factories themselves. The way factories are created plays an ever-larger role in their ability to meet goals, including ones related to flexibility, sustainability, and intelligence.

"It is absolutely necessary for us to have highly efficient and flexible factories regarding all aspects: sustainability, productivity, and global infrastructure. This efficiency and flexibility is the basis of our resilience," says Viessmann. Achieving those aspects connects directly back to the planning process.

"The impact of integrated and collaborative factory planning is immense," Viessmann continues. "Only interdisciplinary teams can manage the complexity and challenges of bringing all operational processes seamlessly together. Regular checks of the key figures for the whole value chain and frequent simulations of the processes ensure that we achieve the required metrics and meet our project goals."

A digital representation of the factory also mitigates the risk of potential planning issues, such as two pipes that will interfere with each other, or incorrect geometrical data about a piece of machinery that is critical to correctly designing the space it will occupy. Heading off such issues via cross-team collaboration at an early stage saves thousands of dollars in site mitigation that would be incurred if the issue only arises at the construction stage. Beyond the construction process itself, the seamless integration and digitization of integrated design processes can also improve the startup of factory operations and the factory's ongoing use.

"We're starting to explore the idea of everything existing digitally before you ever create the physical counterpart," says Kingspan's Glancy. "When you have a digital representation, with the advancement of augmented reality, virtual reality, and such, we can start to walk these buildings, we can even train operators on equipment before [it's put at] the physical site. That [ability] would be a huge increase in terms of improving startup, improving training, and improving quality."

Those benefits continue as long as a digital model is updated as the factory changes over time, becoming a living logbook of the history of the facility. A fully realized model, such as a digital twin, can drive everything from fueling predictive maintenance to speeding retrofits to simulating the impact of proposed modifications to analyzing the performance of materials and the design itself.

"I think people are going to attribute more value to understanding more aspects of a building in the future than they do now," says Glancy.

Streamlining the Factory Design Process

Even as the vision of the factory of the future has evolved, the gap has persisted between that end state and current-day processes for planning and executing factory design and construction. Manufacturers have devised any number of solutions over the years to integrate and streamline the process, so now many steps of the planning process are automated, computer-aided, digitized, and conditions-checked. These advancements serve as the basis for today's innovations, even if they were too far ahead of technical capabilities to work effectively at the time they were introduced.

"In the '90s, they talked about computer-integrated manufacturing (CIM). The idea was to have a 3D model, a CAD model, and to bring it directly to the machine that would produce the parts—a very good idea. But in the '90s that software wasn't at that degree of maturity," explains Breitenbach. "We started with the digital factory in the 1990s. A digital factory is a holistic view on the factory that combines product, manufacturing processes, and the people, machines, robots, and other resources that enable it to operate."

Today, software, data, and communications technology have caught up with the concepts. Experts expect building information modeling processes, digital twins, cameras and sensors, artificial intelligence (AI) and machine learning (ML), and even augmented and virtual reality to support an integrated, collaborative factory design process moving forward. Increasingly, companies will be able to coordinate design activities in real time.

The Aachen University paper defines BIM as a methodology that integrates all stakeholders of a construction project by managing a shared building-related database to facilitate planning, construction, and facility management in operation.

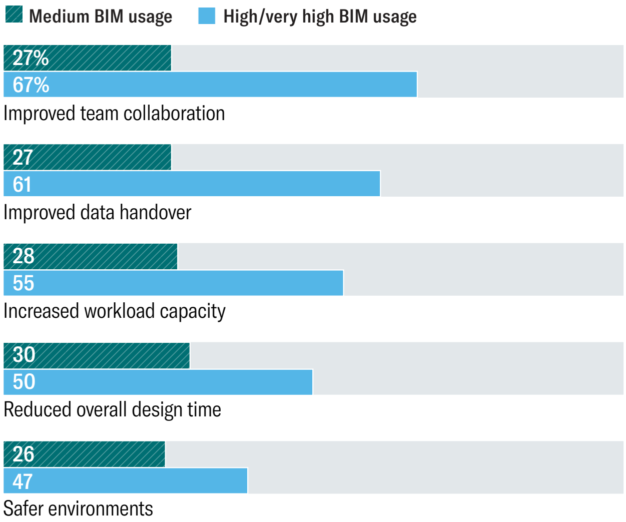
According to research by Dodge Data & Analytics, designers whose work includes high or very high usage of BIM reported experiencing benefits at much higher rates than those with medium usage in everything from improved team collaboration (67% versus 27%) to improved data handover (61% versus 27%) to increased workload capacity (55% versus 28%). **FIGURE 2**

But some see BIM as a process that does not extend to production. "We have BIM processes, but the BIM process starts and ends with the building itself, and at Magna we have

FIGURE 2

Collaboration Tops Design Benefits of BIM

Designers using building information modeling at high and very high levels report the greatest benefits



Source: Dodge Data & Analytics, 2021

> "The digital twin is the nucleus of change for the industry and BIM—the process of change. If we utilize them to deliver a perfect project digitally, we can replicate that physically," says Kingspan's Glancy.

factories," says Magna Steyr's Ostermann. "What BIM does for the building itself, that would be something we want try to achieve for the whole factory design."

What's needed, then, is a way to extend the benefits of BIM to the entire project, integrating planning for the building itself and the machinery and equipment that will go inside it.

Enter the Integrated Factory Model

Digital twins and 3D factory models have emerged as valuable tools to help evolve from the current state of factory design to a fully integrated design process. According to Juniper Research,[1] manufacturing will be the single biggest sector for digital twin deployment in 2021, accounting for 34% of total spend on the technology.

The term digital twin has assumed a wide range of definitions across the manufacturing industry; what some would call a digital twin, for example, others might describe as an advanced/3D model. The Digital Twin Consortium brought together experts to define the term.[2] Its definition describes a digital twin as a virtual representation of a real-world entity and/or process, synchronized at a specified frequency and fidelity. The digital twin uses real-time and historical data to represent the past and present, and then simulates predicted futures that are inspired by desired outcomes and often tailored to specific use cases. A digital twin is powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.

Experts believe digital twins have the potential to transform business and factory projects by accelerating holistic understanding, optimal decision making, and effective action.

According to research by McKinsey & Co., "Companies can improve efficiency and integrate the design phase with the rest of the value chain by using building-information modeling (BIM) to create a full three-dimensional model (a 'digital twin')—and add further layers like schedule and cost—early in the project rather than finishing design while construction is already underway."[3] McKinsey asserts use of BIM and digital twins will materially change the risks and the sequence of the decision making that takes place during construction projects, and put traditional engineering, procurement, and construction (EPC) models into question.

Using such an advanced model for a factory design in process, stakeholders can navigate and view the structure in 2D and 3D from any angle, visually drill down to see specific features, access the specifications related to any given item, trace the history of any changes made to a given element, and more.

At io-consultants, factory designers are "extremely excited about being more instantaneous in their decision-making process and being able to address what-if scenarios at various stages of the design process," says Hoecherl.

In a "true" digital twin, sensors embedded into the factory itself collect data on an ongoing basis to ensure it is always current with the physical building, enabling post-construction use cases. Other ongoing use cases for digital twins in factory operation include understanding what spaces might be affected by equipment failure and comparing actual performance of assets and systems to what is expected. This information can help predict events to improve availability and inform decisions to maximize the return on investment.

Viessmann says his company is using a digital twin to improve communications and collaboration during the planning, design, and building phases of a new production site for heat pumps in Legnica, Poland. Seeing the actual factory layout helps the firm identify and resolve conflicts concerning space usage, bottlenecks, and possible internal "traffic jams" in the digital world during the early phases of the project, and without the high costs or risks that come if these are only discovered later. They also use it to continuously monitor the building progress and adherence to plans, without additional effort.

"We all plan on the same basis, the same agreed status, with no version conflicts from any participant such as industrial engineering, architects, environmental health and safety planners, and all the various production departments that might lead to costly misunderstandings, misinformation, or misinterpretations," says Viessmann.

"The digital twin is the nucleus of change for the industry and BIM—the process of change," explains Glancy. "If we utilize them to deliver a perfect project digitally, we can replicate that physically." He says his company has used digital twins in a model-to-manufacturing approach, creating a manufacturable digital twin as close as possible to an as-built model to troubleshoot proposed details, such as structural steel that can affect the cladding/envelope or a machine placed where a column is planned.

Digital twins and 3D factory models also support integrated factory modeling by reducing the downtime required for retrofit projects and facilitating better collaboration across

By reducing waste and optimizing around efficiency, reliability, sustainability, and related objectives, digital twins, experts hope, will radically improve factory planning and operations.

teams, integrating the views of multiple planning disciplines to support overall goals instead of optimizing from only one point of view. During the building process, a digital twin can simulate construction sequences to help accelerate installation and reduce change orders. Another valuable use case is driving easy and fast supplier integration by allowing a structured integration of any supplier along the entire factory life cycle, from planning to operation. By reducing waste and optimizing around efficiency, reliability, sustainability, and related objectives, digital twins, experts hope, will radically improve factory planning and operations.

"On the one hand, these methods and tools help me in the engineering phase to create a factory or to make changes to the production system," says EDAG's Breitenbach. "BIM and the digital factory map the structures, the product-process-resource, and the digital twin ensures that I can safely check scenarios in advance. In the operating phase, the twin supports me by recording and evaluating operating data. Artificial intelligence applications then offer me the possibility to act proactively—for example, quality measures or maintenance measures."

BIM and digital twins "are technological enablers for us, but we need to design the processes, information flows, and the responsibilities first," adds Dannapfel of RWTH Aachen University. "If we have done that, then [these technologies] can show their true power, because then we have this model-based planning. We have the single source of truth that we can plan with." The visual nature of tools such as 3D factory models and digital twins promises to enrich the collaborative process.

"We're visual people, using technology to demonstrate things and enable people to understand bases, relationships, layouts in a far clearer way. I think it's going to be huge in terms of understanding the outcomes," says Glancy. "When you can walk through a digital twin in a virtual environment, it's easier to have a conversation about what goes where and why it should go there. Because half the battle is actually helping somebody understand the issue. That type of immersive experience will enhance communications with the stakeholders."

A related, complementary technology to digital twins and 3D factory models is generative design, which is also finding its way into more efficient, streamlined factory design processes. Generative design is a design-exploration technology that takes a set of constraints and provides options to filter through to get to the final design. While it has been widely used in the manufacturing industry, it has seen less use to date in construction.

"You could assess multiple line layouts, perhaps even two or three lines in that factory with generative design, and understand this is the best use of space and understand how your operators might function in that environment depending on the layout," leveraging machine learning to participate in the design, says Glancy. "As you see the democratization of all of these technologies, particularly when they are part of the toolkit of new graduates, is when you're going to see this explosion of change. I think it's only three to five years away. It's impressive and scary at the same time."

More Integrated Factory Design Enablers

BIM, generative design, and digital twins aren't the only technologies being leveraged to speed and streamline the design and construction process. The movement toward fully integrated factory design is also being enabled by laser scanning, augmented and virtual reality (AR/VR), the internet of things, AI, and ML. Other essential building blocks include the cloud, shared data models, and collaboration capabilities built into the design platforms themselves.

Laser scanning and camera technology are increasingly in use to generate data, such as to collect and upload measurements for a retrofit project so remote planners can make planning decisions. AR and VR technologies enable team members to virtually visit a building model in progress. Artificial intelligence and machine learning have roles to play in enhancing everything from automating portions of factory planning and maintenance to quality management.

The cloud is proving critical to facilitate easy, shared access to the enormous amounts of data generated by factory planning processes—data which can persist, and hopefully be modified whenever the factory changes, to fuel maintenance activities and ease refurbishment and replanning. Planning data must be well managed to ensure its integrity and availability across teams and their tools.

"For us, the data management system was the biggest challenge," says Ostermann. "A data management system impacted our factory a lot, because in the past, it was difficult sometimes to find the data at the right time." Movement toward

> Integrated communication and collaboration are critical components of these new solutions, so that all teams can access a single shared, real-time view of the factory model.

data standards, which is underway through organizations such as industry groups The Digital Twin Consortium and CESMII—The Smart Manufacturing Institute,[4] should make data management even more seamless.

"I think the people will win that [battle for standards], and software companies will open their books and say, this is our structure," asserts Breitenbach. "You can use it to work with my software, you can work with other software, with this data format. And you won't have any loss of information when exchanging data."

Integrated communication and collaboration are critical components of these new solutions, so that all teams can access a single shared, real-time view of the factory model. It's important that communication activity such as change requests, requests for information, and discussion of issues take place within the collaborative design platforms themselves, to ensure information is always up to date, and accessible to all, and that a record exists of every change made.

"You cannot overemphasize the importance of constant communications to all our stakeholders," says Viessmann. "In order to make the right decision, you need to have the right context and understanding. My experience is that the way of discussions has changed a lot. Historically, construction departments planned the building, and the production planned the process within the building. Today, this direction has changed; many buildings are mainly planned around production processes. Based on communications and simulations, we achieve the best results and the highest performance."

Reimagining Factory Planning for the 21st Century

On time and on budget is no longer the standard by which factory construction projects are judged. Today, planning and construction processes must be fast and well-integrated and support new goals around sustainability and Industry 4.0. Beyond delivering on these objectives, the facility must be easily adapted to future uses and able to minimize its own maintenance and environmental impact.

Technology is proving the key enabler in helping manufacturers and their planning and production partners break down silos in tools, data, and collaboration in their quest for an ever-more-seamless and effective way of planning and constructing a factory. Those advocating for more integrated tools and data, and the processes and culture essential for the success of these tools across the teams that design, build, and operate factories, are optimistic about the potential for integrated factory design processes that reduce risk, save time and money, and create resilient, mutable facilities capable of supporting evolving goals well into the future.

"The planning process, I'm convinced, will always get more integrated," says Hoecherl. "And I think the collaboration will get a lot easier, even across different partner organizations. Digital platforms are key to enable seamless coordination between the different subject matter experts involved by offering access to the latest information. Combined with the advancements in digital twin technology and simulation, we have enablers at our fingertips that offer the potential to front-load projects at a reasonable cost and thereby reduce implementation risk."

Endnotes

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