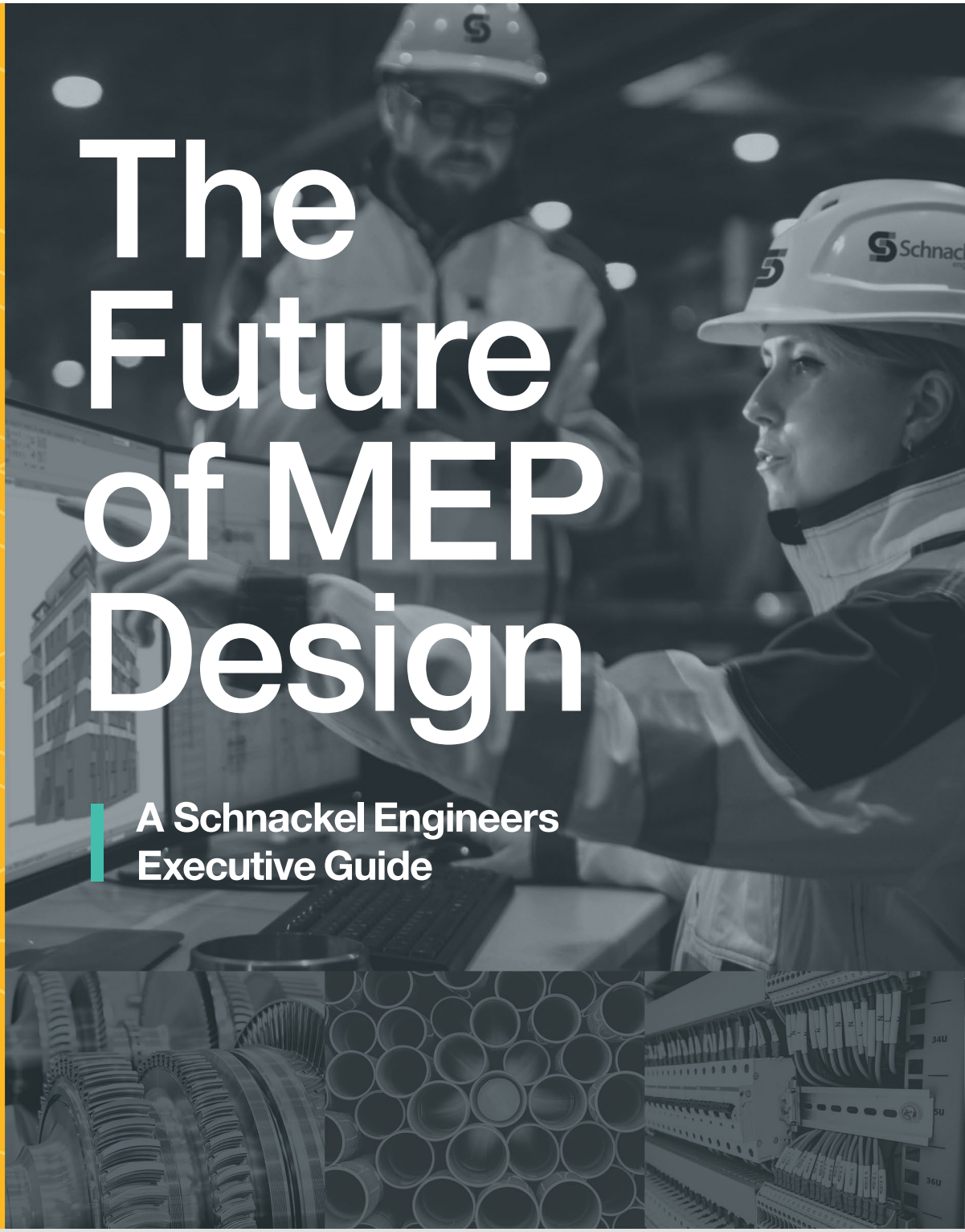
Schnackel engineers

The Future of MEP Design



A Schnackel Engineers Executive Guide

The Future of MEP Design: A Schnackel Engineers Executive Guide

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Introduction

Mechanical, electrical, plumbing (MEP) systems make up a significant portion of any commercial project, and every decision surrounding these systems can have a considerable impact on a project's design. The systems selected, and how they are laid out, drive the look of a project, as well as the long-term operational costs, end-user satisfaction, and overall project costs. By some accounts, MEP systems make up 30% to 50% of the total construction costs[1].

Given the central role MEP systems play in driving design decisions, it's clear that taking steps to improve MEP designs offers tremendous opportunity.

In recent years, MEP design technology has advanced rapidly, achieving new levels of process efficiency, driving decreases in cost and reducing system clashes. Many of these improvements have come by incorporating artificial intelligence (AI) technology. However, there are many barriers that still need to be overcome to drive the improvements needed in MEP design.

We've seen evidence that MEP design technology stands poised to change what architects, engineers, contractors and project owners are willing to accept in terms of design quality and project risks—for the better. Getting to this point, however, will demand that project stakeholders evaluate their priorities and what they must change to achieve improvements in MEP design.

[1] https://www.mortenson.com/approach/how-we-work-content/customer-journey/development-planning-and-design/service-listing-left/design-facilitation/design-phase-leadership/mep-risks

The Future of MEP

The future of MEP design is to utilize AI to improve system coordination and optimization by performing all calculations in a revolutionary, hyper-efficient 3D modeling world, where every step is fully coordinated and detailed automatically by AI-enabled, parallel GPU processing servers. This technology will allow designers to issue shop drawing-quality, fully coordinated models that are designed and clash-avoided in 3D. By employing AI technology, design decisions can be made based on real-time Big Data. This dramatic improvement will connect designs to geographically-specific data sources only available in the Cloud.

The future of MEP design will impact the design and construction process in many powerful ways. Over the next four chapters, we'll outline how MEP technology advancements will impact project costs, architectural design quality and integrity, and project risks, as well as expectations around architecture, engineering and construction (AEC) relationships.

CHAPTER 1

How Future MEP Technology Will Positively Impact Project Costs

Cost overruns have become an expensive expectation for the construction industry. Data from global consultancy KPMG indicates[2] that less than one third (31%) of all construction projects came within 10% of the budget between 2012 and 2015. Among other causes, cost overruns result from change orders or rework needed to smooth over system conflicts not identified during the design phase.

As one McGraw Hill Construction survey[3] found, "On average, owners say they expect to pay somewhere between 3% to 5% added cost on a building project due to these issues, and consider anything up to 6% to still be acceptable as 'good performance.'"

Advances in AI technology, and new owner expectations, are increasingly confronting this overrun acceptance head-on—and pushing designers, engineers and their construction partners to push for conflict-free designs before construction begins.

The Challenges of "Manual" Engineering

MEP systems, being among the largest systems making up any building, are considerable contributors to overall project costs—in some cases, more than a third of total costs. Yet most MEP engineers only apply their knowledge, training and experience to develop a single design solution. There's good reason for this. Using conventional engineering technology, MEP engineers are limited in their ability to work through all possibilities to determine the *optimal* solution to a project's unique design challenges.

Despite the advances made in commercial CADD and modeling programs, conventional engineering remains very much a manual process fraught with inefficiency, inaccuracy and waste. Automating these manual processes using MEP design software with AI technology can have a measurable impact on these problems. Advanced software solutions of the future can run all potential system layouts to identify the right balance of cost and efficiency. It can also reduce potential errors and system conflicts during the design stage, ensuring no expensive rework is required when the systems arrive on-site.

[2] https://assets.kpmg/content/dam/kpmg/pdf/2015/04/global-construction-survey-2015.pdf

[3] https://dbia.org/wp-content/uploads/2018/05/Research-McGrawHill-Managing-Uncertainty-Expectations-2014.pdf

The Impact of Incomplete Data

One of the significant drivers of cost increases is estimates that don't provide enough buffer to account for material and labor price increases. This is further challenged by current industry design processes that incorporate MEP system information from a systems library without any correlation to specific costing data or, in most cases, any costing data at all. Designing in a cost vacuum, as it were, makes it difficult to accurately estimate or find the best solution. Construction contractors risk going too high (and thus losing a bid) or too low and opening the door to cost overruns throughout the life of the construction process.

That stands poised to change. MEP software technology already in development will be able to use real-time, geographically specific costing data. Through this smart data, engineers can establish the most cost-efficient, energy-efficient and environmentally conscious design for every project, regardless of its location.

The Result of Cost Control

Keeping costs on track doesn't just mean lowering the costs of redesign and rework. Poorly designed and poorly coordinated MEP systems waste precious capital that can be better spent on creating a more functional, efficient and aesthetically pleasing built environment. So, new AI technology solutions that reduce rework to rein in project costs can give project owners and architects confidence that their projected cost estimates are reliable and free them to focus on value-added items. By lowering MEP costs through more efficient design processes, architects can allocate more of the project budget to visible finishing work and better program execution.

Equally important, more efficient MEP systems can reduce long-term ownership and operational costs. By investing in reliable design engineering upfront, owners can develop a solution that's better for the environment and their bottom line.

CHAPTER 2

How MEP Technology Improves Architectural Design Quality and Integrity

Most architectural and MEP designs are developed to meet an increasingly wide range of project requirements. There are, of course, cost and aesthetic expectations. There are also sustainability, energy efficiency and carbon-reduction requirements to meet. Then, there are the layers of local, state, federal and, in the case of heavily regulated industries, other specific codes that must be met.

By reducing conflict in the design stage, designers and engineers can improve design integrity.

Balancing these needs is a challenge that architects are better able to meet with today's advanced architectural design technology. Building Information Modeling (BIM), virtual reality modeling and other advanced design tools are making strides in reducing change orders by allowing designers to identify more conflicts upfront. By reducing conflict in the design stage, designers and engineers can improve design integrity.

Yet this technology hasn't been able to entirely eliminate change orders that arise from system conflicts discovered in the field. Without accurate, real-time, coordinated data from all trades contributing to building systems, it's difficult to eliminate potential jobsite conflicts. What's more, the tools in use today still require a human BIM manager to review system data and make coordination decisions manually, often in a sub-optimal manner.

By adopting the next generation of automated MEP design tools, system designers and engineers can rapidly run through an infinite number of project options and confidently select the option that meets all requirements most efficiently.

The Balancing Act

AI is transforming what's possible in architectural design. By bringing AI technology into MEP design processes, engineers can generate countless potential MEP layouts, ensuring they are able to identify the layout that will best meet all project requirements. This range of requirements might include the most affordable option for meeting energy-efficiency specifications and lowering the project's carbon footprint during construction and operation. It can also ensure that MEP systems have the least intrusive plan footprint possible, a particularly critical factor in repurposed facilities or in dense urban areas.

Through advanced AI computational design technology, architects gain confidence that the MEP solution they select is the best of all possible solutions that makes the optimum use of the planned space and project resources. This data can also give project partners confidence in a reduced likelihood of change orders, and their resulting cost and schedule overruns, and thus allow the freedom to focus on more visible, value-added design work.

By beginning with more reliable design, quality can be improved through the entire construction process.

Strategies for Best Results

Automating the MEP design process is the first step toward ensuring accuracy built around fully coordinated designs, but it's not the only step. To ensure that this technology gets to the best quality architectural design, it's critical that engineers work with the entire design team using the most accurate data possible. As computer scientists say, "garbage in, garbage out."

The biggest beneficiary of this improved design process should be the project owner—but it's important to make sure that they know it. Take time to explain upfront how technology is being used to drive a smooth, swift and conflict-free construction process. This upfront work can help build trust and win projects. The long-term operational results can build strong and lasting partnerships for future work.

CHAPTER 3

How MEP Technology's AI Strategies Can Lower Project Risk

In recent years, more advanced design software has allowed architects to develop increasingly complex projects. From geometrically unique facades to integrated building systems to the use of novel materials, architectural design is pushing the limits of what is possible in the built environment. However, in many ways, the process of engineering and implementing these designs is still working to catch up.

As a result of the overall trend of pushing buildings to do more, MEP requirements have also become increasingly more demanding. Sustainability goals and climate change commitments are driving project imperatives for energy efficiency, while the need for flexible space utilization in urban areas or among repurposed facilities are pushing designers to locate MEP systems within ever-smaller spaces. As these system requirements become more complex, answering to more demands, the risks begin to mount.

Pushing too many demands upon MEP systems can lead to compromises in system quality or higher long-term operational costs. More immediately, these risks are manifested as field conflicts, design changes and aesthetic compromises, all of which pushes back on schedules and budgets.

The problem, of course, isn't the advanced design software. It's a lack of such advancement from partners and subconsultants further down the design chain. Now, through AI-based strategies, MEP technology is poised to advance and support architectural expectations while lowering overall project risks.

How AI Strategies Are Changing Design

The use of AI-based computational MEP design software stands ready to make a significant impact on the risks that have plagued architectural projects in the past. By applying AI strategies to evaluating countless potential MEP layouts, MEP engineers can run multiple design scenarios to ensure the selected systems will provides the greatest return on investment while meeting all project requirements.

Advanced new AI-based software can also automate the process of identifying potential system conflicts before contractors ever step foot on the jobsite. Reducing these system conflicts during the design stage can prevent many of the pitfalls that derail projects during construction. Through AI, MEP engineers can preemptively address the leading sources of project risk during the design stage before systems are manufactured or contractors are onsite.

Reducing system conflicts during the design stage can prevent many of the pitfalls that derail projects during construction.

What's more, automating this process gets results rapidly. Speeding through this formerly laborious step to a reliable conclusion also speeds the process of securing permits and beginning construction.

Evaluating a New AEC Risk

Doing work "the way it's always been done" is part of what has made the AEC industry a laggard in efficiency and technology adoption. Yet, in an industry where relationships and shared experience can be a powerful driving force, many project owners and AEC stakeholders will have to reevaluate their priorities.

In many ways, this opportunity presents its own risk: the risk of working with a new partner within a new paradigm. Relationships are critical in the AEC business. However, moving outside the comfort zone of an established subconsultant relationship can free architects to discover better solutions to address their chief problems. Ultimately, this move should reduce project risk, not increase it. After all, working with a partner that is taking the initiative to reduce the chance of design errors is hardly a risk—it's an opportunity to make jobs run smoother in the field, resulting in more satisfied clients and repeat business opportunities.

CHAPTER 4

How MEP Design Technology Will Change AEC Relationships

Strong relationships sit at the heart of many professional relationships, and this seems particularly true in the AEC industry. In fact, an AIA Business of Architecture survey[4] highlights the critical nature of relationships among architecture, engineering and construction firms and project owners. Surveyed architecture firms specializing in commercial projects reported that 78% of their work came from repeat clients; for institutional projects, 74% of billings stemmed from repeat clients.

Some owners placed even more emphasis on this need for prior experience, as 83% of office, education, and healthcare owners report that previous experience with a firm is important when they select an architect. This emphasis on relationships tends to trickle down to an architecture firm's design partners, including MEP designers.

A strong foundational relationship can give partners a strong sense of certainty when facing many unknowns at the start of a design or construction project. But does this focus on a comfortable relationship hinder the opportunity to advance with innovators? Or does technology stand poised to put an end to strong AEC relationships?

Adding Value in New Relationships

Believe it or not, the application of advanced technology stands to help MEP engineers become better value-added partners in the design process. A leading goal of this software, after all, is to drive more confidence in the integrity of the design and the selection of specific systems and layouts.

When MEP engineers are supported by AI-based computational software, they are able to prioritize the more aesthetic implications of decisions rather than solely concentrating on functional needs. AI-based software automates the process of designing wire, pipe and duct runs inside the walls, thereby letting MEP designers focus on the more visible components that the building occupants can actually use and enjoy.

[4] https://www.architectmagazine.com/aia-architect/aiafeature/how-to-align-your-firm-with-client-needs_o

Reimagining Collaboration

This ability to free MEP engineers up to interface with the design team and end-users, rather than focusing on the ducts, piping and wire hidden behind the walls, hints at yet another way that technology can help revitalize AEC relationships. AI may be the future, but MEP design and architecture will always require a human touch. The human interface is critical to understanding and meeting the expectations for the MEP systems as well as the overall building design.

In fact, the strength of AI is that it provides more opportunity for collaboration. As Accenture Research experts James Wilson and Paul Daugherty wrote in Harvard Business Review[5], "Through such collaborative intelligence, humans and AI actively enhance each other's complementary strengths: the leadership, teamwork, creativity, and social skills of the former, and the speed, scalability, and quantitative capabilities of the latter."

Embracing Innovative Partnerships

Realizing the full potential of next-generation AI-powered MEP design technologies may require working with new partners. It will become increasingly important for architects to develop relationships with subconsultants who are able to innovate, add value and reduce risk at every step of the project. Working with innovative partners, including those who embrace AI as an integral part of the design process, will drive the development of overall better buildings—and build a stronger foundation for new AEC relationships.

[5] https://hbr.org/2018/07/collaborative-intelligence-humans-and-ai-are-joining-forces

Conclusion

The Evolution of MEP Design

Given MEP systems' tremendous impact on the overall project, it only stands to reason that improvements in MEP design technology will significantly improve overall design efficiency. This includes its role in reducing initial construction costs as well as reducing the system conflicts that lead to cost and schedule overruns during construction.

In the future, MEP computational design technology must support improvements in the overall design integrity to provide greater value to project owners. A key part of improving project value will be decreasing the risks that have become an all too familiar part of many construction projects.

It's clear that AI can produce better, more efficient, conflict-free solutions faster than any conventional human engineering process. However, AI-powered computational MEP design stands as a perfect complement to human engineering knowhow, not a direct replacement for human engineering. AI removes the drudgery of routing and sizing systems, allowing human engineers more time to get the aesthetics and function right for a more pleasurable experience in the space. By utilizing machines to do what they do best, human engineers can do what they do best: create a more efficient design and a smoother construction project for all.

As AI-powered MEP design improvements take hold in the industry, AEC professionals must examine their partner relationships to determine how to best move forward into a more efficient and reduced risk AEC world.

History

When Schnackel Engineers first began working in CAD, there were none of the symbol libraries, layering systems and line type standards that are commonplace today. The firm had to develop its own symbol libraries and drafting standards to streamline design work. Later, as commercial CAD software packages advanced, our company moved to writing macros and scripts that could automate certain basic drafting functions. Since that time, technology has advanced rapidly.

In the early 2000s, AutoCAD released the structure of its CAD database and provided a programming interface to allow external programming languages to manipulate the CAD database. This opened the door to performing engineering calculations and other functions in any software programming language desired, allowing manipulation of the objects in the CAD database directly. Schnackel Engineers jumped on this opportunity and began the process of teaching the computer how to do the engineering and routing calculations for MEP systems. With this, the final D—Design—could be added to the CADD acronym.

Today, Schnackel Engineers' AI-powered computational MEP design software is able to test all viable design solutions in a quest to determine which solution best meets all of a project's specified requirements at the minimum cost and least environmental impact. This evolution in MEP design processes is where we see the industry headed.