

The performance advantages of digitizing the built environment

Why projects should begin with the end in mind



Introduction

Organizations responsible for the design, construction and management of the built environment—and the owners who define asset requirements—have always faced challenges on many projects, whether new construction, refurbishment or repurposing an asset. Confronting economic, regulatory and environmental pressures, the engineering, construction and operations (EC&O) sector is seeking solutions to answer a great many challenges. At the forefront is improving shrinking profit margins by enhancing efficiency, reducing construction waste and adopting lean methodologies.

Meeting these challenges requires transformative change. Much of the technology to facilitate change in the EC&O sector exists but, in many cases, is being underutilized. What's missing is a steadfast commitment by all involved not to simply build to meet a need today but also to consider improving asset performance over its entire lifecycle.

This transformation effort must consider future economic, social and environmental consequences—which can often be controlled by decisions that are made today. In short, peak performance, throughout the lifecycle of the asset, requires projects to begin with the end in mind.

Challenging times for all of EC&O

Today's EC&O organizations are stressed by global competitive pressures, rising costs of materials and labor, ever-changing regulatory requirements, skilled personnel shortages, and customers who are both more sophisticated and demanding.

Globally, clients have seen the positive impact of technological advances in other industries. Now, there is growing demand to construct “smarter” office and residential buildings, industrial plants, public and private infrastructure, and similar assets in the built environment. These activities require significant capital expenditures, but many firms are reluctant to add intelligent features to the asset. They might mistakenly believe that making such investments today will only yield results in the long term. In reality, making smart decisions now that are based on future probabilities can also produce positive near-term results.

“...research has indicated that an improvement of just 3.8 percent in productivity in the functions that occur in a building would ... pay for the facility's design, construction, operations and sustainment through increased efficiency.”¹

The role of technology in EC&O

Most businesses working in the EC&O sector have adapted and integrated modern tools into their processes. Perhaps the most transformative advance that benefits all parties in the EC&O sector is building information modeling or BIM. It is the foundation for digitizing the built environment. In 2011, forward-thinking designers, builders, asset managers and owners in the UK realized that using BIM could help them reap significant benefits and should be required on all government-funded construction projects. In 2016, this requirement became a reality when the UK began mandating use of BIM Level 2 for these projects. See the feature box about BIM levels for more information.



One of the most important concepts to understand about BIM is that it is not a technology—it is a process that can benefit every part of the EC&O value chain. BIM can help asset designers, constructors, operators and owners adapt more easily and efficiently to changing usage. And, as BIM advances to Level 3 and Level 4, the benefits will extend far beyond the initial engineering, construction and daily operations of an asset. BIM is the basic building block for the future of the built environment.

More about BIM levels

BIM Level 2, the current minimum target set by the UK government for its projects, focuses on collaborative working where all parties use their 3D CAD models but are not necessarily working on a single shared model. A common file format helps each organization share design information with others, as well as implement data from others into their own model.

BIM Level 3, also known as Open BIM, is targeted toward full collaboration among all disciplines that will use a single shared project model as a centralized repository of all design information. This level will allow all parties to access and modify the same model, helping reduce the chance for conflicting data. While there are copyright and other legal issues to be resolved for this level, it represents a vast improvement in cooperation that should yield further efficiencies.

BIM Level 4 has not yet been fully defined. But it is expected to enable a future where much more than design aspects, construction materials and methods, and basic operational requirements will be considered. From the beginning of the project, Level 4 will likely incorporate more data about people—particularly end users. It might also provide input on social issues and implications, long-term environmental impacts, and desired outcomes for assets in the built environment. It is expected to represent a major step forward in EC&O.

The Egan Report of 1998

The EC&O industry is not the only industry that has faced huge transformation in the digital age. Sir John Egan is a British industrialist who was chief executive and chairman responsible for the turnaround of Jaguar Cars from 1980 - 1990. Egan was chosen by the UK government to undertake a review of the EC&O industry because of his extensive knowledge and successful contributions in transforming Jaguar and others in the manufacturing industry. Understanding the parallels between EC&O and manufacturing, he applied this same thinking to help reshape engineering, construction and operations of the built environment. The Egan Report, published in 1998 by the construction task force chaired by Egan, laid out a bold new path for improvement in all sectors of EC&O. The report concluded, “What we are proposing is a radical change in the way we build... To achieve the dramatic increases in efficiency and quality that are both possible and necessary, we must all rethink construction.”²

This kind of forward thinking in the manufacturing sector has helped deliver more efficient processes along with higher quality and more socially responsible products using innovative approaches to recycling and reuse. To participate in the kind of productivity increases manufacturing has seen, EC&O businesses should now rethink the way assets are made and managed, whether created through new construction or refurbishing.

“While only a very small portion of facility lifecycle costs occurs during design and construction, those are the phases where our decisions have the greatest impact.”³

Begin with the end in mind

Most owners of buildings, roadways, factories, bridges, railways and other large complex assets already understand the importance of BIM. Obviously, it can save time and money by creating a central source of information about the design, engineering and construction of these assets. But many have also recognized

that BIM is far more than simply an elaborate 3D model. Those owners within EC&O, with an eye toward the future, also understand that improvements expected in BIM 3 and 4 can play a vital role in improving the long-term performance of assets throughout their entire lifecycle.

The adoption and evolution of BIM is also going to change roles that companies within the EC&O industry can profitably fulfill. Companies across the industry are becoming more aware and focused on the entire lifecycle of assets, which helps provide consistency in management across design, construction, operation and decommissioning. As construction becomes more modular and digitized, builders will be required to find new ways to remain relevant. For example, instead of managing an entire project and its myriad subcontractors, some contractors might choose to become manufacturers of building subassemblies. Others might become project managers who oversee and curate the digital technology and information at the heart of the BIM model. One thing is certain: digitization of the built environment is inevitable. It is up to individual contract firms to decide where they can best add value.



Owners are in the best position to drive the rapid adoption of new thinking throughout the EC&O sector by requiring that projects be created and completed to achieve a variety of forward-looking goals. By carefully considering the desired future outcomes of the asset at the beginning of the process, decisions can be guided by tomorrow's benefits rather than simply today's expenses. Following is a brief introduction to concepts that can offer potential positive impacts for assets in three specific areas: social, economic and environmental.

Improving social outcomes

As the world population grows and becomes more urbanized, the end-user experience for each asset will become an important consideration. For example, when building or modernizing a healthcare facility, the true end goal should be better patient outcomes. This objective gives new incentives to EC&O businesses, as well as asset owners, to contemplate new parameters for every project. The layout, traffic patterns, specified parts and fixtures, and operational controls incorporated in the construction or remodeling of a facility can all contribute to better patient care and results after completion.

Delivering better economic performance

First, if the asset is created with lifecycle performance as the primary goal, the initial costs of an asset should be reevaluated and compared to the possible future gains. In a significant number of projects, concentrating on the lowest up-front price as the major focus might, in fact, lead to substantially higher operational expenses over the lifecycle of the asset. In many cases, some of these lifecycle costs can be reduced or eliminated by simply taking into account the future life of the asset.



Helping protect the planet

With the global environment under stress from a multitude of factors, it is both smart and socially responsible to create assets that do not worsen the situation. One key concept here is the “circular economy.” Currently, most assets are created in a linear manner that might be described as build, use and demolish. The circular economy offers new hope for reusing and recycling building materials into new structural components that help EC&O organizations find new ways to reduce the carbon footprint of the built environment. In addition, it also means that at the beginning of any project, deliberate thought should be given to ways the asset can be repurposed when the original use is no longer needed or economically viable to continue.

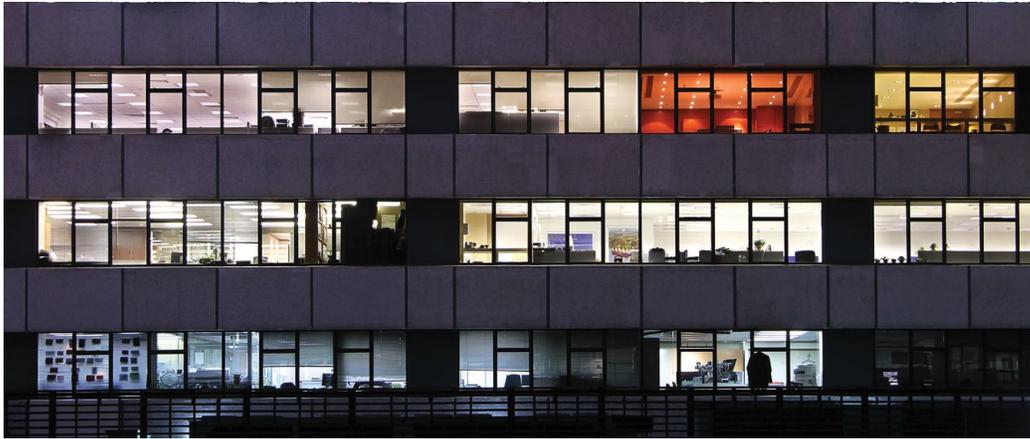
[This short video](#) explains more.

Cement is a major construction material but not eco-friendly. A key component of concrete, it accounts for at least five percent of all global CO₂ emissions.⁴ Also consider that China used more cement between 2011 - 2013 than the US used in the entire 20th century.⁵ BIM, along with lean construction methodologies, can help reduce the environmental impact of major EC&O projects.

EC&O of the future

As discussed earlier, the key requirement is beginning projects with a focus on the future performance of the asset throughout its entire lifecycle. It also requires working together to close the gap between design intentions and operational outcomes. BSRIA is a UK test, instruments, research and consultancy organization owned by the Building Services Research and Information Association. It provides specialist services in construction and building services, and has developed a process to facilitate the highest performance of an asset called Soft Landings.

The Soft Landings process “requires clients to appoint designers and constructors to stay involved with their new building beyond practical completion and into the critical initial period of occupation. This will assist building managers during the first months of operation, help fine-tune and debug the systems, and ensure [that] the occupiers understand how to control and best use what they have been given. This is followed by a longer, less intensive period of aftercare lasting for up to three years, to monitor energy use and occupant satisfaction, and to check on the operation of systems that might need seasonal fine-tuning.”⁶



But this process represents only one of many future possibilities. Take for example an office building. Currently, operational improvements, such as automatically turning off lights in unoccupied rooms, are aimed primarily at energy savings. While reducing energy usage is worthwhile, consider that energy costs can comprise as little as 10 percent of a company's total asset expenses. So a 10 percent savings here is only a minimal reduction in actual costs. On the other hand, many estimates of a business's operational expenses show that often as much as 60 percent of a company's expense is the cost of personnel. In this case, small percentage gains in productivity can create large savings at the bottom line.

Consider the improvements possible with BIM in place. An unexpected incident on a construction site—weather changes, personnel availability, equipment downtime—could automatically update the BIM model and notify others. In turn, elements within the supply chain could make adjustments of deliveries or synchronize equipment availability with work site conditions. This ability could improve efficiency by notifying those individuals involved in off-site activities, as well as rescheduling “just-in-time” deliveries to better accommodate the changes.

In addition, the BIM model becomes a living record of what, when and how elements are constructed, which helps improve decision making.

What if your building could automatically recognize the amount of light necessary for optimum productivity throughout the offices? Specifying dimmable lighting at the project outset allows the offices to be properly lit based on the level of ambient light available. When the sun shines brightly, lights are dimmed; on cloudy days, lights burn brighter. In addition to energy savings, this type of automated response also helps workers perform well regardless of light conditions outside.

Factors such as indoor air quality, lighting, thermal comfort, acoustics and many other attributes should be an important consideration at the beginning of every EC&O project. Smart investment in automated, adaptable systems can yield great benefits going forward when you consider the end user—even when that initial choice is not the least expensive option. Again, with the performance of the asset over its entire lifecycle as the driving force, it becomes easier to make better up-front decisions that can have a greater impact on future operations and outcomes.

Conclusion

The smart assets you create going forward could become a huge instrument for change throughout the entire built environment. As technology delivers deeper, more timely insights, assets can become more thoughtfully designed, more efficiently constructed and more economically managed. To make this possible, transformative changes are needed today across the EC&O value chain to help the industry prepare for a tomorrow that is more economically successful, socially responsible and environmentally sensitive.

Information is the foundation for these changes. Due to the large amount of data used within the EC&O sector, improved technology will effectively enable the analysis of a multitude of asset data sets. These data sets can supply near real-time insights to help you make better decisions, faster. You need an agile business model that can adapt to new requirements quickly to help prevent wasted time and resources. And you need advanced asset management tools and predictive software that can help you address problems before they become critical.

BIM is one of the key information components required for the transformation of EC&O. Level 2 is a good start, but the promise of Level 3 and Level 4 indicates even more important advancements will be possible in the future. Level 3 will provide a common model for all parties to help create efficiencies in each stage of an asset's lifecycle. With Level 4, the addition of more data about people, social factors and environmental considerations can enhance these efficient processes and improve satisfaction among end users as well.

The choices that are made as a project begins can have the largest, longest-lasting effects on the entire lifecycle of an asset, from design to construction to operation. Beginning with the end in mind might include selecting options that increase the productivity of people who will work in an office. It might also include choices that improve outcomes for patients who will visit a hospital or decisions that can increase profitability for owners

of a railway. Business transformation alongside a practical, intelligent digital strategy can be instrumental in helping every EC&O company create and maintain assets that will deliver higher performance for decades to come.

IBM is committed to transformation

For more than a century, IBM has been helping businesses of all kinds around the globe meet the changing requirements of their customers by enabling dramatic transformation of business models and processes. IBM offers a wide array of tools and solutions to help designers, builders and operations professionals maximize the value and usefulness of every project.

For example, IBM® Asset Lifecycle Management Solutions (ALIM) are a group of services that bring data together so that asset, supply chain and program information can be provided at the point of need. Using BIM-generated information combined with a host of other data sources, ALIM can provide a “golden thread” of information to help disparate systems speak to each other and provide continuity end to end. By combining cloud, data federation, semantic modeling and predictive analytics, ALIM can help you remove silos and work smarter.

For more information

To learn more about ALIM and how IBM can help you as the built environment becomes more digitized, connect with Desmond Conlon at ibm.com/connect/ibm/uk/en/resources/des_conlon You may phone him at +44 23 9228 9738 or email DConlon@ie.ibm.com

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- ¹ United States National Building Information Modeling Standard (NBIMS) Version 1 - Part 1, 2007, Web, April 2016, https://www.wbdg.org/pdfs/NBIMsv1_p1.pdf.
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