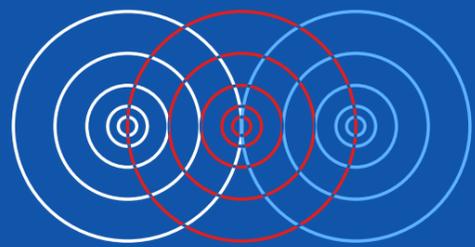


# THE INEFFICIENCY PROBLEM

Cracking the code for  
AEC business success

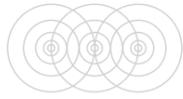


Image courtesy of East China Architectural  
Design & Research Institute



# DEFINING THE RULES

The top 3 seismic shifts facing your firm



Shift 1.

## MOUNTING EXTERNAL PRESSURES

Today, 54% of the world's population live in urban areas, a proportion that is expected to increase to 66% by 2050, according to a [UN report](#). Projections show that urbanization combined with the overall growth of the world's population could add another 2.5 billion people to urban centers by 2050.

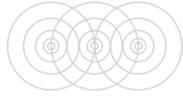
Governments and private project owners are challenging the architecture, engineering, and construction (AEC) industry to more efficiently provide housing, schools and health facilities in these dense, overcrowded areas, as well as the essential utilities and transportation systems for people and goods.

To compound matters, the cost of many of the natural resources used in construction, such as petroleum, natural gas, and timber, is rising. These resources are also becoming less desirable to climate-conscious

clients. Demand for more sustainable design increasingly influences the types of construction materials being used, boosting the performance of buildings and infrastructure over their lifetime.

At the same time, clients understandably want you to do more, for less. They too are under budget constraints and are motivated to drive down the costs of building and maintaining their assets to get as much value from them as possible.

Finally, regulatory agencies and industry associations see immense value in the project information, data documentation, and collaboration made possible through building information modeling (BIM). Mandates for BIM continue to expand within and beyond country borders. Even in countries where BIM is still optional, many firms are adopting BIM processes to improve project performance, advance asset management, and ultimately gain more value from investments. And, more importantly, many clients already expect your firm to be BIM-ready.



Shift 2.

## INCREASED COMPLEXITY AND INTERNAL EXPECTATIONS

**In addition to increasing pressure from macro-economic factors and client expectations, you likely face challenges within your own firm.**

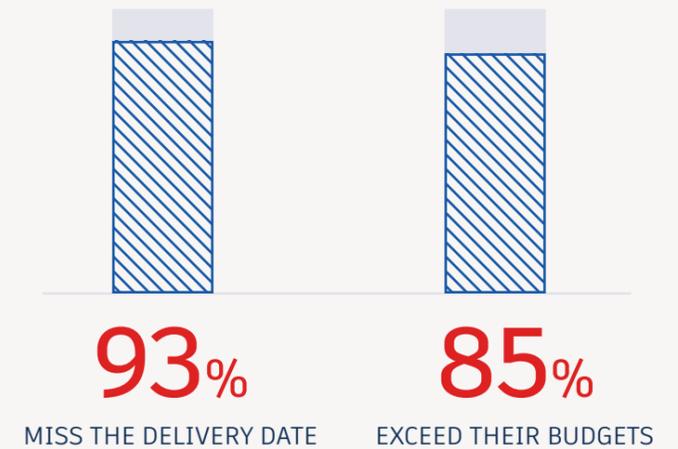
All too often, projects run over time and over budget despite your best efforts to avoid this. [Research](#) shows 93% of building owners report projects as running over time, and 85% say projects exceed their agreed budget. Sometimes this is down to the fact your clients request changes but, in many instances, inefficient workflows are to blame.

In an [EIU survey](#), 74% of construction industry professionals said that their senior management team recognized productivity growth as a challenge. And 32% of construction professionals cited “poor

communication and collaboration” as the single biggest hurdle to improving productivity. The nature of much of today’s design and engineering work requires multidisciplinary teams working together. But, with traditional design processes, you’re often left figuring out whether you have the latest updates to the design model or waiting to collect the latest versions from other parties.

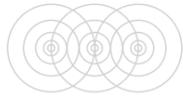
Your firm is also up against global competition in ways that it never was previously. If you work in the energy or transportation sector, for example, you’re often competing on an international stage for major projects. And you likely want to hire the best talent to help you in this. Many firms that were unable to recruit as they would have wished during the economic downturn now find that competition has grown intense.

A [Dodge Data & Analytics study](#) revealed serious performance issues in buildings:



“Many of the drivers of low productivity are a result of market conditions. It’s not just clients demanding contractors do more with less; it’s the increasing skill gaps, low construction volumes and increased competition that are forcing companies to take on projects with tight margins.”

[Michael Skelton](#)  
Head of market strategy  
AECOM



### Shift 3.

## TECHNOLOGY DISRUPTION

**Innovations in digital technologies are disrupting every industry, and AEC is no exception.**

Technology plays an important role in how we approach the design, engineering, and construction of buildings, roads, bridges, and other infrastructure. And it is creating new opportunities for us to radically transform the way we deliver projects.

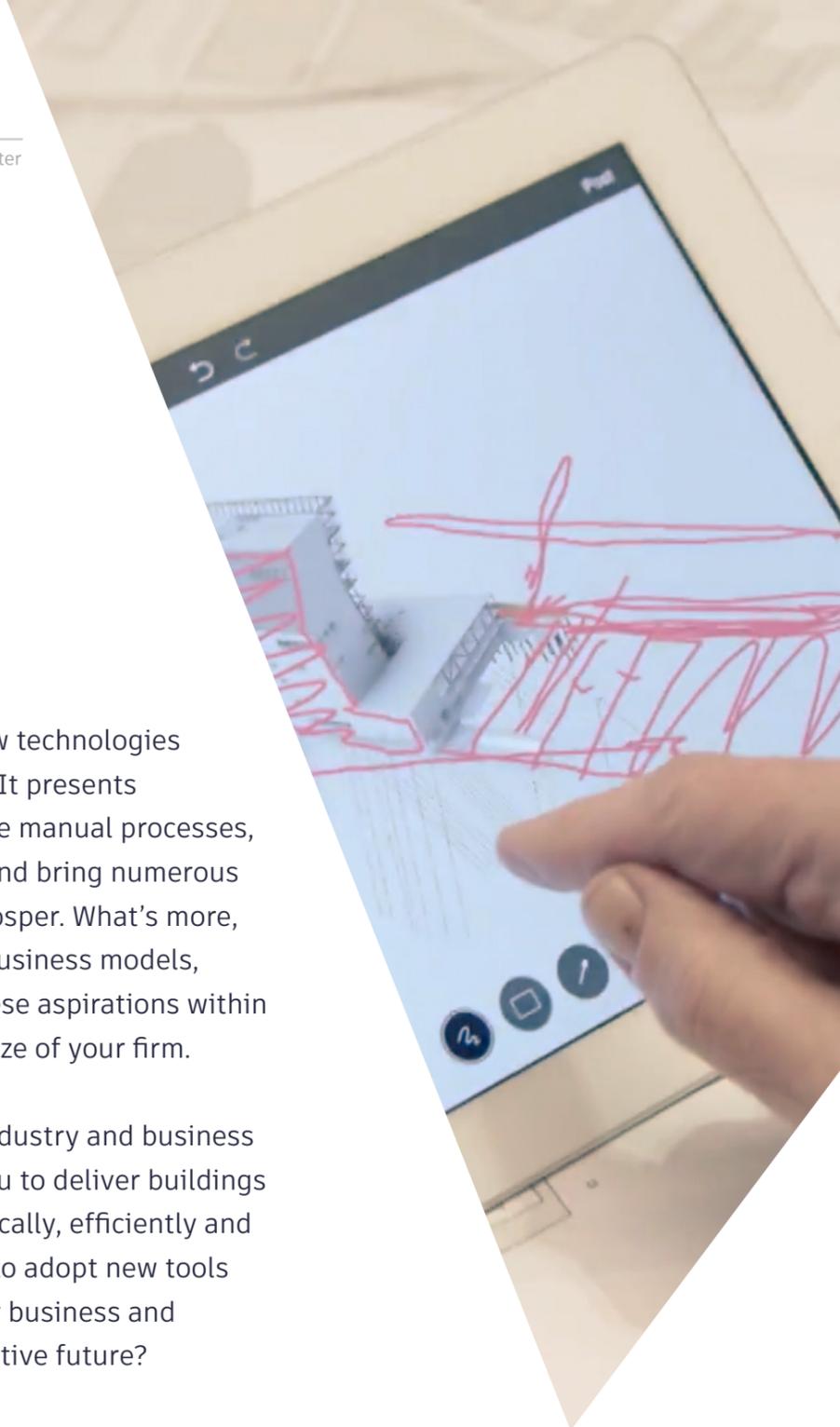
Imagine, your clients can now stand in an unbuilt space and, with reality capture and augmented reality tools, visualize how their project will look in the context of the existing environment. Consider using the Internet of Things to collect and analyze data in real time, so you can better design future assets and enable operators to maintain and manage buildings and infrastructure more effectively. You could design **buildings with exterior skins** that automatically react

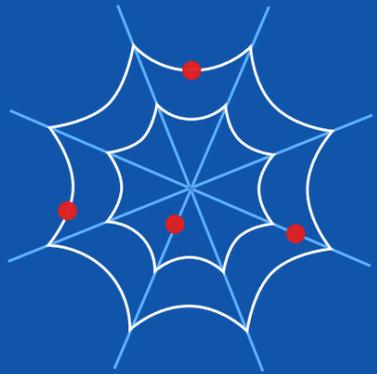
to the sun and dynamically adjust throughout the day to manage light and heat gain, making them more sustainable and energy efficient. And inbuilt sensors in gantries or signs could collect and analyze traffic data, making it easier for operators to proactively respond to congestion or accidents on the highway.

Meanwhile, cloud computing is quickly becoming the backbone of the design process, creating opportunities to facilitate design iterations, analysis, and better collaboration. Cloud-based services enable you to more easily evaluate various design options and choose alternatives that meet your most important design criteria. In the cloud, teams distributed across distances can more easily collaborate on models in real time. With direct input from key stakeholders representing the project disciplines, your project can benefit from design efficiencies, better design quality, and reduced risks and uncertainty for the life expectancy of any building or infrastructure.

The continual introduction of new technologies is positive for you and your firm. It presents opportunities for you to automate manual processes, radically streamline workflows, and bring numerous benefits to how you work and prosper. What's more, when paired with more flexible business models, technology innovations bring these aspirations within your reach today, whatever the size of your firm.

Given these global trends, and industry and business constraints, how prepared are you to deliver buildings and infrastructure more economically, efficiently and sustainably? Are you persuaded to adopt new tools and processes to streamline your business and unlock the key to a more competitive future?





# THE WORKFLOW CONUNDRUM

Plotting your escape from the top 4 inefficiency traps



So, you're ready to move to a more efficient way of working. The good news is that the technologies and methodologies you need to make this transformation already exist. You can take what's available and use it to create a smarter way of working throughout the full project workflow and escape from the top inefficiency traps.

Trap 1.

## A LIMITED, TWO-DIMENSIONAL VIEW

While 2D CAD tools have their place, you cannot fully rely on them for concept design or rapid prototyping, which makes it difficult for you to explore the full range of design options.

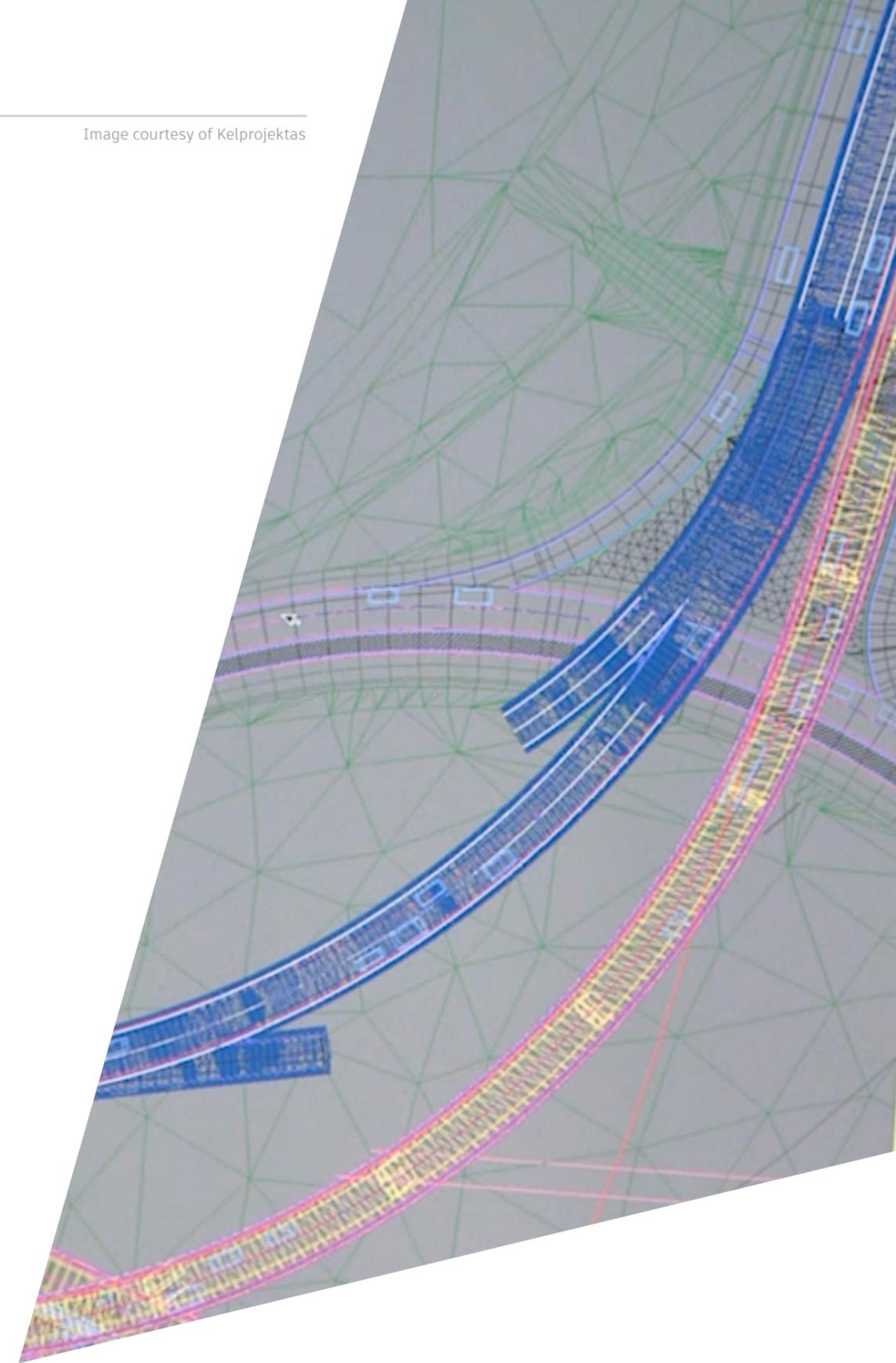
Model-based design centers on the concept of project data brought together to generate an intelligent 3D model of your project and is at the heart of more innovative design processes. Designers, engineers, and other stakeholders can share this model throughout the lifecycle of the project and, eventually, the constructed asset. As designers and engineers develop the project design, the model data grows richer.

As a project increases in complexity, the advantages of model-based design become more apparent. A rich model enables you to more easily address competing design parameters, making it possible for you to

quickly test the viability of different approaches early in the design phase, so you can spot and correct errors that may cost you dearly further down the line.

As a civil engineer, you can model different types of intersections and roadway configurations. You can use simulations to show the actual traffic volumes at different times of the day to see how different options perform. And, if you're an architect, you can use the digital model of the building to analyze thermal properties and natural light for healthier outcomes.

You can employ this same exploration as you make virtually every decision throughout the entire design-build process, so outcomes can be much more predictable. The result is a faster and more efficient workflow that leaves you focused on what you do best: delivering quality designs.





Trap 2.

## DESIGN IN ISOLATION

**The components of a building or infrastructure project only make sense when they come together, so why design them in isolation?**

Improved collaboration with team members from various disciplines at the earliest phases of the project can better ensure your designs are feasible from the outset, helping to improve the overall quality of the project.

With a cloud-based 3D model, you have one central place to work through the design, and everyone collaborates on the same model in real time.

You can more easily share work in progress with all stakeholders, helping to ensure that everyone is focused on the right detail. Everyone sees one another's work and accounts for it as they go. You can even invite contractors to review the model from a constructability perspective, facilitating the viability of designs from the earliest design stages.

Since any user can access the model, from anywhere, you no longer have to be located in the same room as your colleagues to collaborate. This makes it possible for you and your firm to experiment with more collaborative models like integrated project delivery and joint-ventures and, if needed, include specialist partners from anywhere in the world.





Trap 3.

## UNINSPIRING, INCOMPREHENSIBLE PRESENTATIONS

In a world where 3D gaming and CGI movies are commonplace, 2D drawings can appear lackluster and, for those outside of the industry, downright perplexing.

With detailed 3D renderings, you can create more stunning visualizations of your design intent and use them to get even the most cynical on board.

No matter how small your firm, rich design models make it possible for you to create full 3D renderings and interactive experiences to better show stakeholders and the public what your final designs will look like. You can use these visualizations to impress clients at the initial bid stage and to support conversations throughout the entire design-build process. As for the public, you can better present how your project, whether a building or roadway, might impact their daily lives, and thereby speed up the planning process.

For stakeholder meetings and presentations to the public, you can overlay a 3D design on a model of existing conditions to create a realistic depiction of what your building or infrastructure will look like in situ. You can even take clients or local residents on a virtual tour. The 3D presentation, in the context of what's there now, along with the information behind the model, provides a compelling and intuitive explanation for non-technical people. You can even input suggestions given during meetings and display and analyze revised models in real time to accelerate consensus.

You can also use 3D models as the primary means to communicate plans to the people who will use the buildings and be impacted most by the infrastructure. If you're designing nursing stations at a hospital, you can show the nurses the designs and get their feedback. They'll be able to easily visualize how the stations will look. You can also walk contractors through the design prior to construction, enabling them to work out the most effective way to approach the build.

“There’s definitely a ‘wow’ factor when clients (and prospective clients) see the renderings and walk-throughs we’ve created. But from our vantage, these visualizations are simply the best way to communicate a design and provide superior engineering design services.”

[Lee Kopsaftis](#)

Director of AEC services

DLB



Trap 4.

## DESIGN DIVORCED FROM REALITY

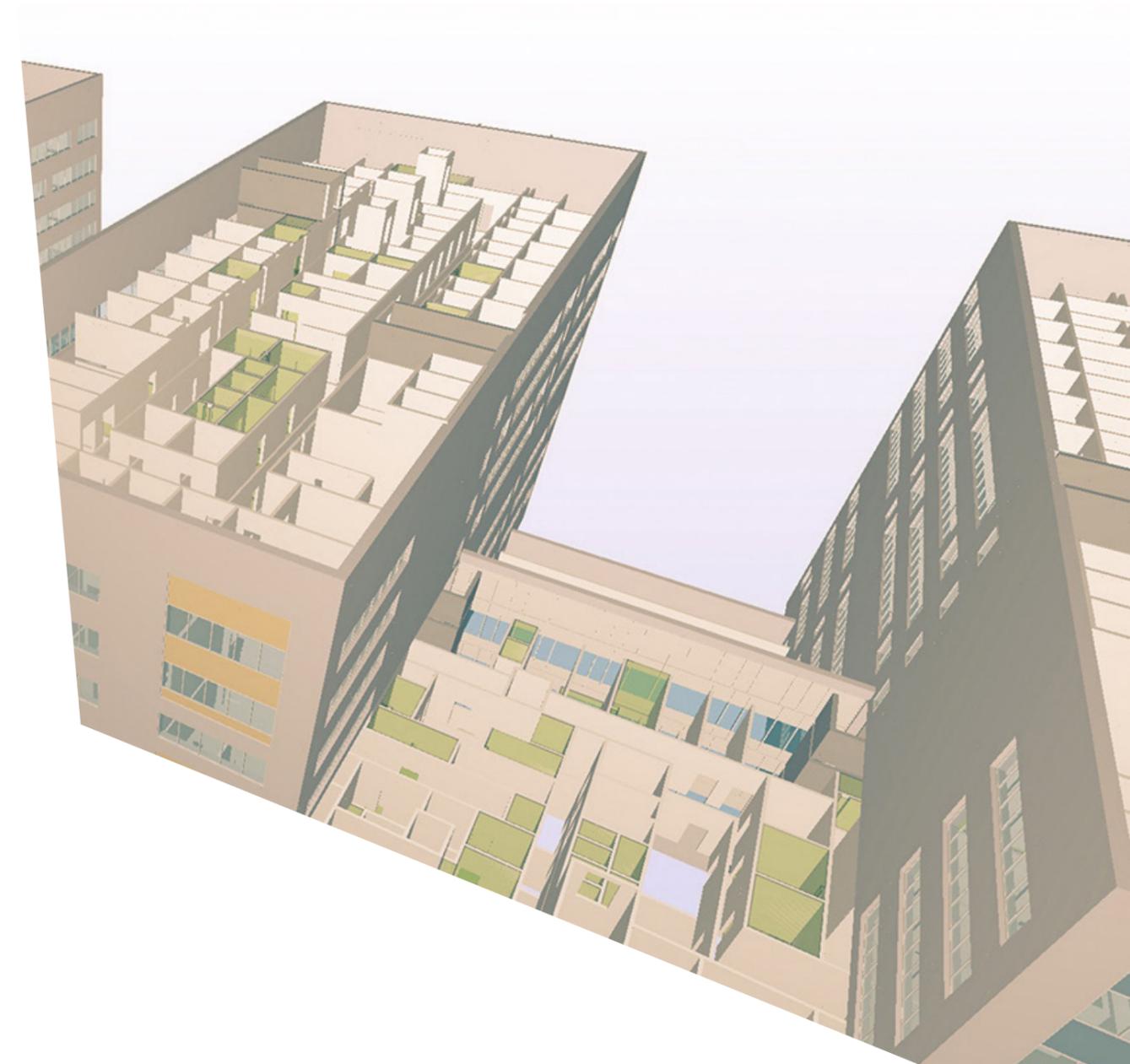
Conventional topographic surveys take time, while inputting this data in design programs can take even longer. This means, as a designer, you don't always have the clearest picture of your project's reality.

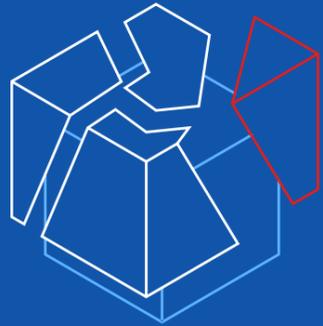
Using light detection and ranging (LiDAR), 'reality computing' allows you to directly capture spatial information about the physical environment of your project through photography, laser scanning, existing geospatial and survey data, and more, and then integrate this data about your project's existing

conditions into your design model. A 'point cloud' provides detailed ground-surface measurements, as well as accurate representations of assets such as lamp posts, curbs, storm drains, guardrails, signs, overpass and underpass clearance and complexity, and surrounding vegetation.

As a designer and engineer, this helps you improve the quality of your project deliverables by allowing you to build your design model based on the real-world conditions and environments of your project. Having a clearer, more realistic understanding of your project from the beginning helps extend your project dollars to work smarter, faster and cheaper.

Reconstruction of the Krasnoyarsk Regional Clinical Hospital, Russia  
Efficient workflow and connected teams are helping to advance the design as much as 60% faster for key processes—while furthering the team's goal of zero clashes.





# FITTING THE PIECES TOGETHER

The case for action



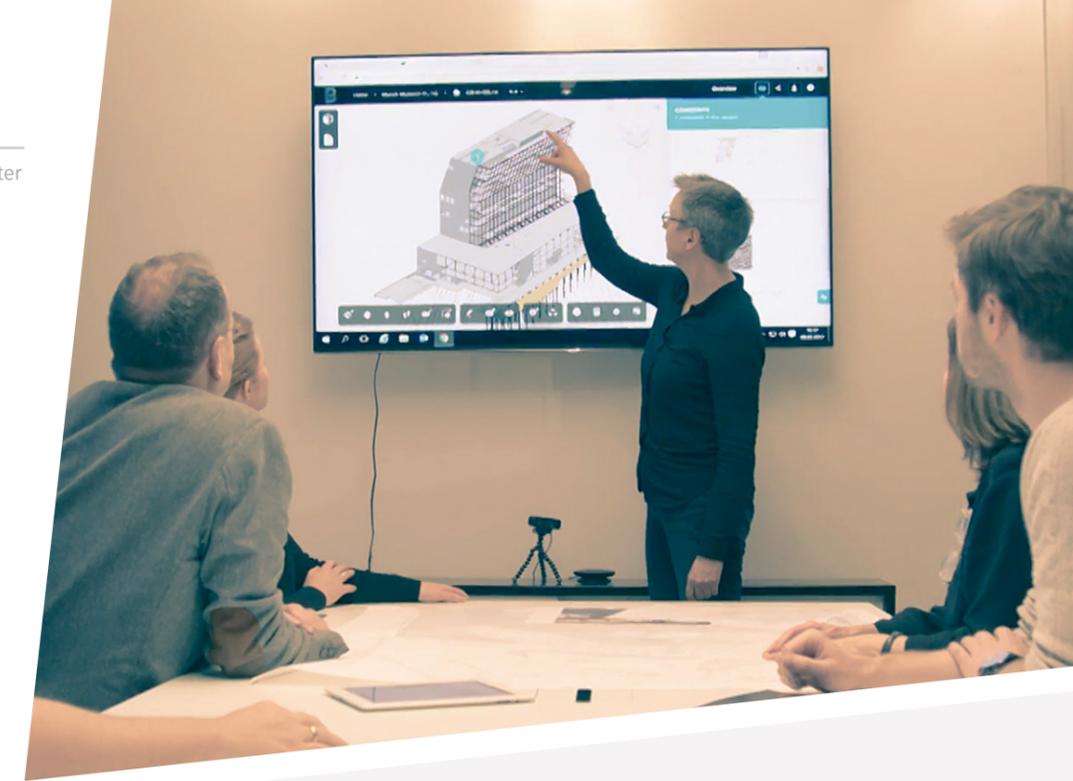
You've read about the macro- and micro-level changes driving transformation in your industry and the possibilities created by transitioning to more efficient, model-based processes supported by the latest technologies. The benefits of change are compelling, but why should you act now rather than further down the line?

## WIN WORK

The trend towards BIM is well underway. In some countries, BIM is already mandated and, in others, firms are adopting BIM processes regardless. Those who have taken the journey to BIM rarely go back. And many clients already expect you to be BIM ready. In fact, [research](#) shows 81% of US companies consider BIM capabilities when making their selection for project teams. Consequently, transitioning to more efficient, model-based workflows is not just your key to winning more work, it is fast becoming crucial to working, period.

Typically, this means success in a competitive bidding process; and BIM can help you stand out when you pitch your firm to clients, especially in countries where it is not mandated. Experience with BIM can also help your firm to compete globally, particularly in countries that, lacking their own established standards bodies, are likely to turn to international standards.

Having BIM capabilities puts you in a position of strength, helping you better respond to client and regulatory mandates, while the market for non-BIM projects is likely to shrink and become even more intensely competitive.



**Clients increasingly require BIM on their projects, with government mandates becoming a catalyst for change in many countries. For example:**

- The General Services Administration (the largest owner of commercial space in the US) and US Army Corps of Engineers require BIM on all major projects
- UK government projects must use BIM Level 2 as part of a program to cut capital costs, delivery schedules, and carbon usage
- Germany is planning for a BIM mandate by 2020
- The EU BIM Task Group is aiming to harmonize BIM in public works across the EU. Other governments already adopting BIM at least partially include France, Italy, Spain, Finland, Denmark, and the Netherlands
- Authorities across Asia, Singapore, China and Australia are all increasingly using BIM
- In the UAE, Dubai Municipality requires BIM for government buildings that are over 20 floors



## MAKE MORE PROFIT

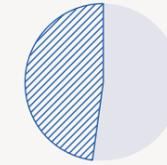
### BIM processes have many benefits over two-dimensional practices.

You can experience fewer errors, change orders and delays, since you are able to gain consensus on models from all parties early in the design phase and detect clashes on a computer rather than on the ground. And, having a digital record of what has been done makes it much easier for you to reuse lessons learned. You'll be better equipped to deliver more projects on time, on budget and, as your productivity improves, you can benefit from higher profits.

With BIM, you could also start offering services that you may be sending to outside consultants today. Imagine, you could analyze the energy use of your proposed design within simulation tools or turn to speciality energy analysis tools that work with your model to offer your clients new services around energy use and performance of their buildings or infrastructure.

As projects wind down, you could provide clients with as-built records of their assets that more accurately reflect the final design models delivered. These models help your clients operate and maintain their buildings and infrastructure more efficiently. They can also be an ongoing source of work, with your firm helping the owner keep the model current as changes are undertaken.

A [survey](#) of large architecture, engineering and contracting companies identified the following benefits of BIM:



**48%**

SAW A CUT IN THE FINAL CONSTRUCTION COST, OF AT LEAST **5%**



**51%**

SAW A REDUCTION IN THEIR PROJECT SCHEDULES, OF AT LEAST **5%**



**31%**

SAW A **25%** IMPROVEMENT IN PRODUCTIVITY

By embracing BIM processes, you will improve productivity and the quality of your work and will benefit from higher profits.

“Architecture firms of every size struggle with margins. BIM offers new avenues to improve profitability. Completing tasks faster helps, but the increased insight and control you see with the BIM process opens the door to an even larger opportunity. Firms that master BIM will find that they can begin to charge both for design work and for realizing agreed upon outcomes, such as design time or construction cost.”

[Phil Bernstein](#)

Vice-president for strategic industry relations  
Autodesk



## RETAIN CLIENTS

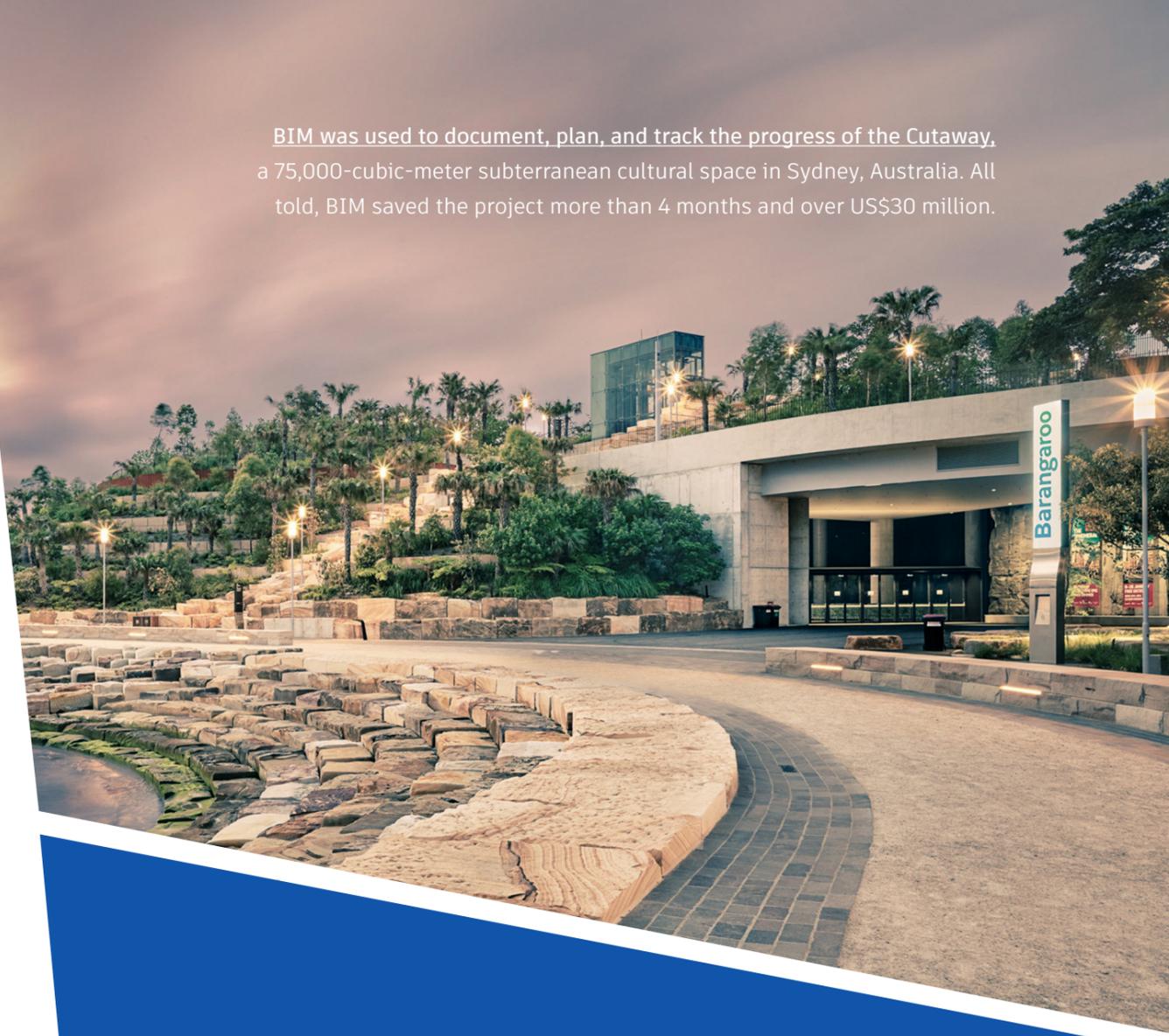
Once owners experience the benefits you can deliver with BIM, they're more likely to be reluctant to seek design help elsewhere.

During the design process, the ability to perform iterations and realistic visualizations will help you communicate design intent and you and your clients to make more informed decisions. Model-based design processes will help you reduce the risk that a client's expectations will not match their requirements nor the expectations or their own customers.

Of owners that use BIM, [research](#) shows 93% feel that their projects meet their quality expectations. Meanwhile, another [study](#) revealed the same number found that BIM improved the quality and function of the final design. When you use BIM processes, owners also benefit from the availability of accurate and rich data to help them better operate and maintain buildings and infrastructure over the long term.

Finally, for owners, time is money. [Research](#) shows nearly half of them found that BIM accelerated project completion. Happy clients are easier to manage and are more likely to return and refer new clients to your business too.

[BIM was used to document, plan, and track the progress of the Cutaway](#), a 75,000-cubic-meter subterranean cultural space in Sydney, Australia. All told, BIM saved the project more than 4 months and over US\$30 million.

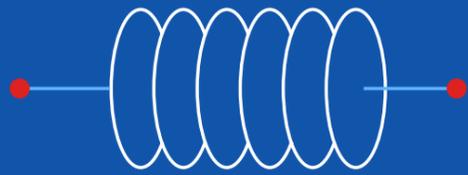


“BIM has changed the industry because, when used well, it leads to better buildings and better results for clients. We've been able to share BIM with clients and show them why it matters. BIM means fewer surprises in the field, better collaboration, and increased efficiency.”

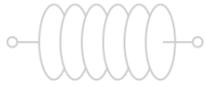
[Ruth Baleiko](#)

Principal

Miller Hull Partnership



# DRIVING THE ROUTE TO BUSINESS SUCCESS WITH BIM



## There's never been a better time to make the transition to model-based design processes, and we're here to help.

Autodesk's Architecture Engineering & Construction (AEC) Collection enables you to adopt 3D, model-based BIM processes more efficiently and effectively. With the AEC Collection, you have a broad portfolio of BIM technologies along with CAD-based toolsets, allowing you to make the move on your terms. And, capabilities for more interoperable model-based workflows supported by mobile and cloud technologies, mean greater insights into all phases of your project lifecycle.

You can start by improving your existing workflows, using tools you are already familiar with today. As an architect or building engineer you can use Autodesk® Revit® to take your project from conceptual design to construction documentation. You can create intelligent structure models, and more easily evaluate how well they conform to building and safety regulations. And you can design MEP building systems with greater accuracy and in better coordination with architectural and structural components.

As a civil engineer, you can start with Autodesk® InfraWorks® to aggregate large amounts of data to establish the existing conditions of your project in

the context of the real project environment. You can more easily create preliminary project designs, evaluating different design alternatives as you develop early detailed designs in your model. And you can complete the detailed design of your model and deliver construction documentation in AutoCAD® Civil 3D®.

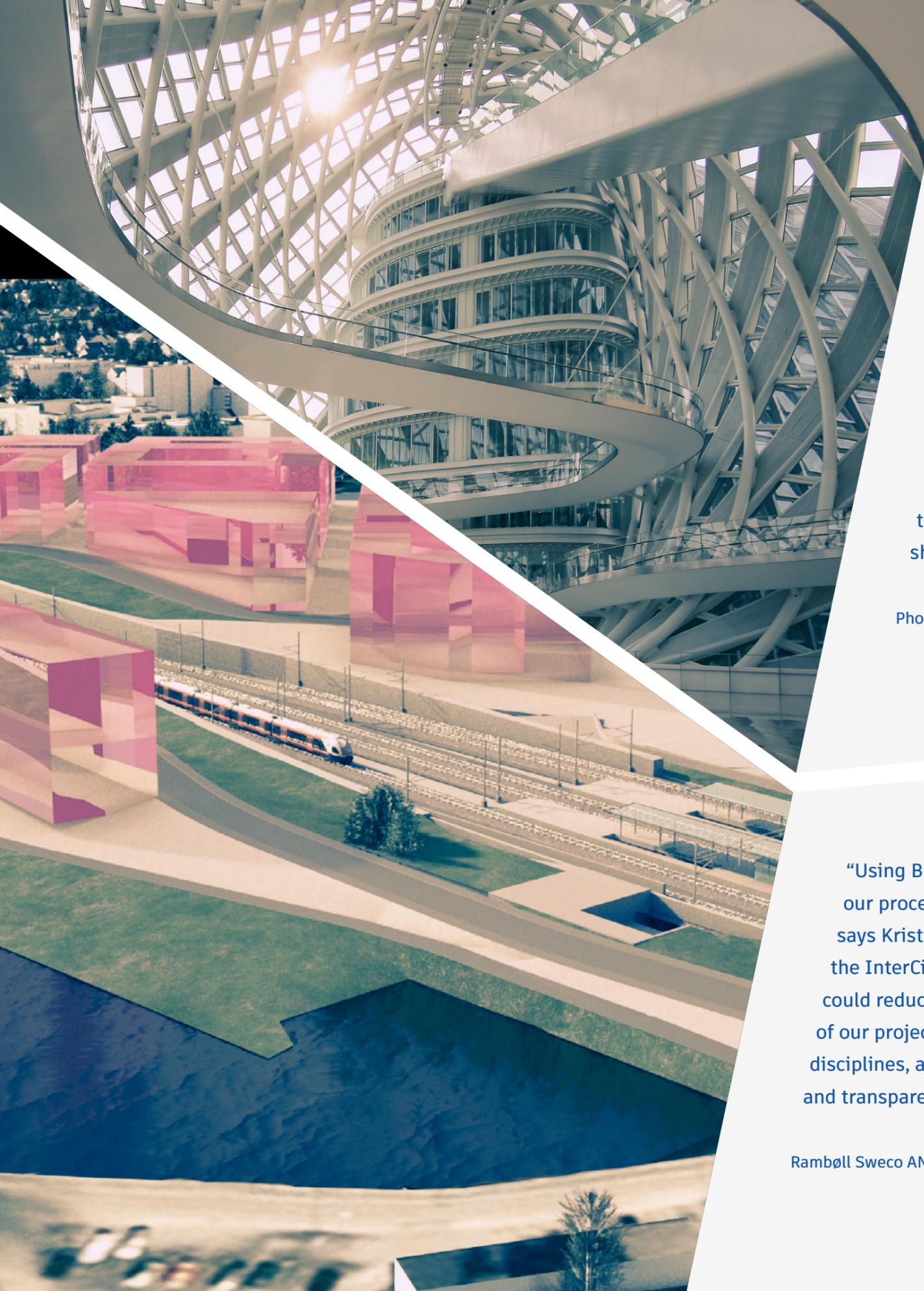
You can access additional tools in the AEC Collection to produce stunning visuals of your project, helping you communicate your project's impact to key stakeholders. You can also access capabilities to improve the quality of your designs, minimize errors and omissions, improve constructability, and facilitate construction scheduling.

With a subscription to the AEC Collection, you can use the tools you want, when you need them, and let our partner network support you on your BIM journey. Work more effectively with your entire project team, across the lifecycle of the project. BIM provides the means and mechanism to ensure that your project can contribute toward more efficient, sustainable and resilient buildings and infrastructure. The AEC Collection aids this advancement by facilitating design, engineering and construction via a collaborative and quantifiable process. Imagine how BIM could transform your work, your business and your project outcomes, today.

## MAKE IT HAPPEN

In the move to BIM, roles and tasks will change. To ease the transition, consider setting up a regular training schedule, together with on-demand learning and a team of BIM experts who can drop into a project to offer extra support when required. You can boost your organization's culture by bringing together younger staff more skilled in parametric modeling with your more senior staff, who have more project delivery experience.

Many organizations start by creating a BIM Manual, with standards for sharing information to ensure collaboration is smooth. Key to your success will be the creation of a central database for the project, establishing a common point of truth. With mobile technologies and the right toolset, anyone in the world can contribute, and you can be certain that the model is always current, and teamwork is strong.



Images courtesy of BIAD  
and Rambøll Sweco ANS

“Some buildings with complex forms separate the internal space from the form, but we took an integrated approach,” says Zewo ZHOU of BIAD (Beijing Institute of Architectural Design), the architects on the project. “The outer shell of the structural ribs bears the load of the entire building and textures light within the building. BIM brought the team together and gave us the insight we needed to use the complex shape to improve building performance.”

Phoenix International Media Center

“Using BIM as a planning tool improved our process on nearly every front,” says Kristin Lysebo, BIM Manager for the InterCity-project. “With BIM, we could reduce the environmental impact of our project, optimize designs across disciplines, and increase democracy and transparency in our planning.”

Rambøll Sweco ANS

## YOU CAN SOLVE THE INEFFICIENCY PROBLEM BLOCKING YOUR BUSINESS SUCCESS

The Autodesk AEC Collection provides flexible, on-target solutions that can help. Learn more by viewing our workflow videos for better [building design](#) and [infrastructure design](#).

