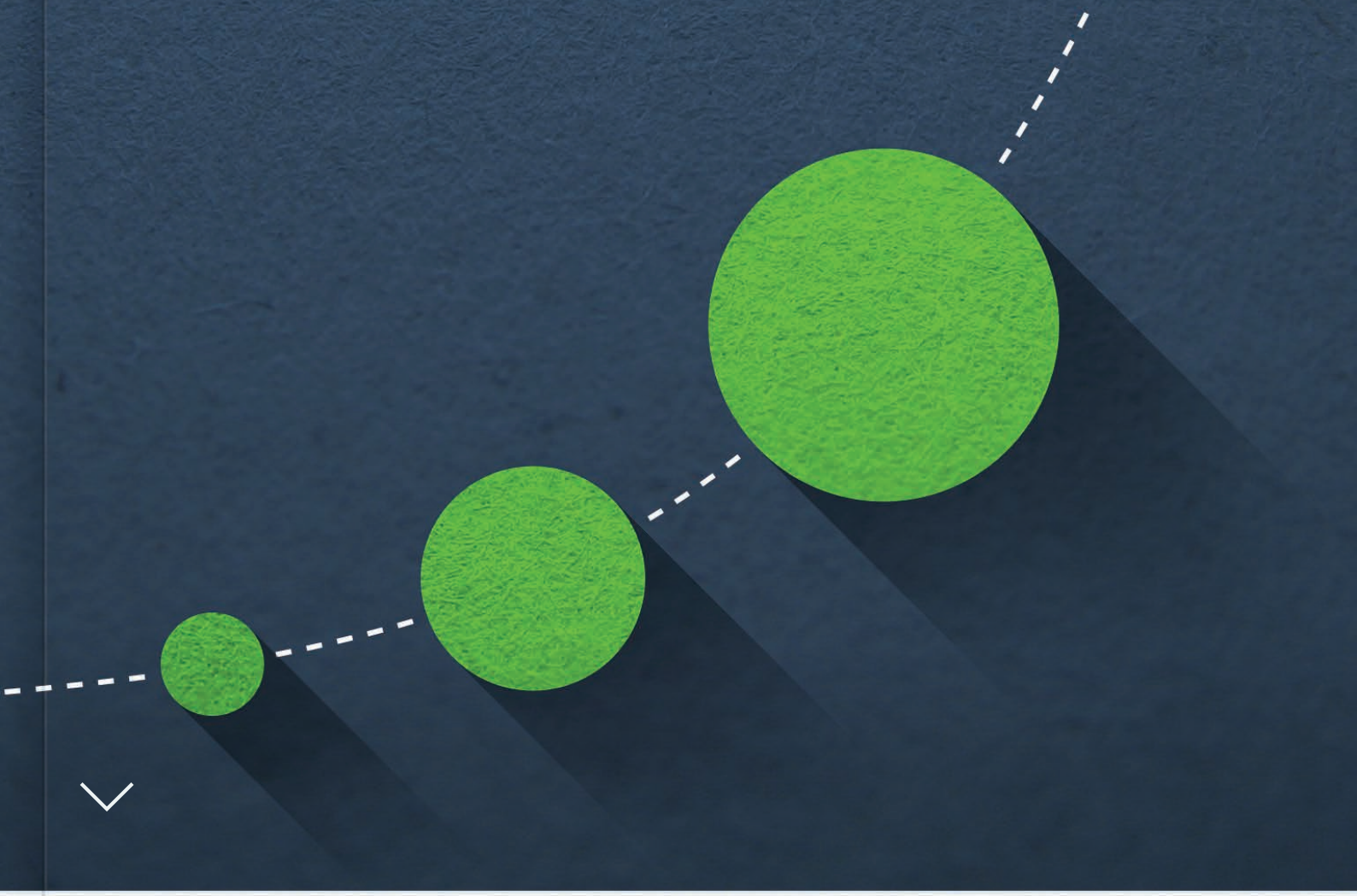
WHITE PAPER

BIM FOR INFRASTRUCTURE

THE IMPACT OF TODAY´S TECHNOLOGY ON BIM

How Technology can Transform Business Processes and Deliver Innovation



8 MINUTES READING

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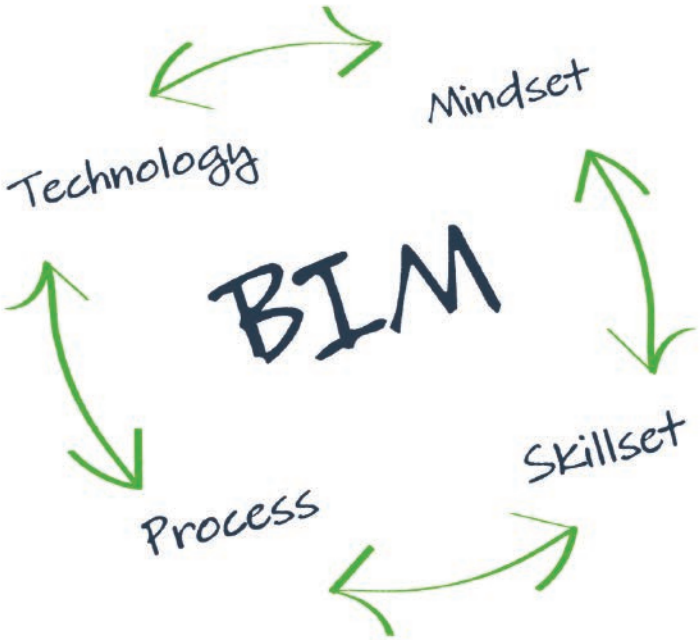


TECHNOLOGY IS CHANGING BIM

Digital technologies and the internet are changing business operations in ways that have not previously been seen. The rate of innovation and the convergence of mobile, social, cloud and information continues to accelerate.

BIM itself is not a technology, it is an information-rich, model-centric business process with the power to transform project delivery and add value across the full lifecycle of the infrastructure assets – plan, design, build and manage. BIM is a knowledge system about the way things get built.

Technology is what enables the transformative potential of BIM for the construction industry. Technology enables the creation and use of intelligent 3D models and also connects all project parties and stakeholders. Allowing collaboration and the free-flow of data about what is being designed and how it will be constructed in ways the construction industry has never seen before.

So, how does the available technology help address the challenges and opportunities that BIM brings? Here's what you need to know.

Putting big data in context

No infrastructure project exists in a vacuum. BIM helps to collect, analyse, and aggregate the huge amounts of data necessary to connect designs to the context of the surrounding environment. Major advances in how infrastructure models are created make use of vast amounts of data related to the project environment and its constraints. The latest BIM for infrastructure technology employs dynamic engines to make the connections between design and reality with its intuitive object-oriented and rules-based design and decision making.

"There are huge amounts of survey data available for free in government GIS databases. We included data for land, geology, flooding, natural resources, agriculture, and forestry into our 3D model. Next, we began fine-tuning the route and determining the engineering needs for each segment."

Marius Sekse
BIM Manager for Infrastructure, COWI

GIS data is essential for this model-centric approach, but GIS data alone does not add context that can be critical to decision making and communication. Now it is possible to unlock that information for real-time use, with location-based data acquisition and management capabilities.

Civil engineers, planners, contractors, and owners have immediate access to geo-referenced data directly in the infrastructure model. GIS – as a system that stores and analyses geographic information – is simply becoming one component of the BIM process.

The design authoring tool is a lens into an almost infinite source of data – using intelligent objects to represent real-world assets within the actual context of the surrounding environment.

Actionable reality

Reality capture | Capturing existing physical conditions is critical at every point in the lifecycle of an infrastructure asset. Traditional surveying is one method, but existing conditions are now as (if not more) likely to come from reality-based point clouds captured via laser scanning or digital photographs (photogrammetry). Sensors that capture real-time data, ground-penetrating radar – even crowd sourcing – are other examples of emerging reality capture technologies that will revolutionised the type, accuracy, and quantity of data available for infrastructure assets, existing and proposed.

The key is connecting reality to the design model, so that the rich data can be accessed, analysed, and adapted over time. For example, contractors create interim as-builts that update the model during construction, and owners may monitor performance of current designs, such as traffic patterns or the load on bridges and roads.

Virtual reality | When it comes to portraying proposed reality virtually, the industry is moving far from what has been called "Hollywood BIM" to visualisation that are created directly from the model and contain all of the underlying data. These animations can have just as much "blockbuster" appeal visually and help facilitate more effective connections to the public to speed the approvals process. Emerging technology now offers the ability to interact with, manipulate, and scale the data in real time. Planners can sketch multiple scenarios (even while meeting with clients or the public) and understand the potential impact of design options well before moving into design phase.

"Having a 3D model that can be quickly modified helps the client make better decisions, faster."

Marius Sekse
BIM Manager for Infrastructure, COWI

Augmented reality | The goal of this approach is to make the future a reality. Using augmented reality, any stakeholder can connect to an array of complex information in the context of what's real. Then spatially referenced mobile devices can take the model off the desktop and into the field. The technology has valuable applications for construction asset management, enabling real-time insight into the existing infrastructure location.

More accurate and contextual data translates into higher levels of confidence in the project design, improved communication, and more efficient management of completed assets.

Cloud-based optimisation

There is one area where technology advances have proven to be disruptive that new possibilities are open to designers, contractors, specialist trades, and building operators. The development of cloud platforms, coupled with the increasing power and accessibility of mobile devices has further enabled the extension of the use of model and project data across the supply chain.

For example, engineering analysis connects the design to data and is critical to success. But it also can be the most resource-intensive and error-prone part of the process.

With cloud-based computing, multiple iterations of very complex analyses can be done in near real time – versus minutes, hours, or even days. This ability provides greater project clarity earlier in the design process and can reduce the need for costly expert analysis or hardware.

Applying Computational Fluid Dynamics analysis to a project is no longer a decision based on affordability. Generalists and designers can now run analysis more often during conceptual design – using the information to guide choices and better ensure optimal outcomes – before an expert validates the results later in the detailed design stage.

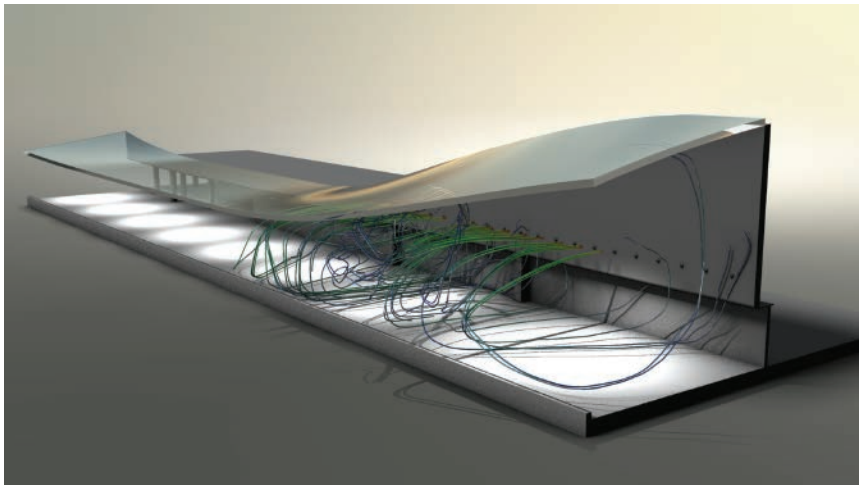
> "The cloud makes all data structures implicit (available) instead of explicit ('send it to me). The challenge lies in how to best organise the data for total access. You can't do BIM workflows with index cards and Microsoft Access; knowledge systems must provide a standard for representation. The BIM workflow is now 'how do the disciplines exchange value to progress the work?'"
>
> **Phil Bernstein**
> Autodesk

With the virtually infinite power of cloud-based parallel processing, it will soon be possible to do simultaneous analysis of multiple factors in a shared model environment.

This multi-variable optimisation will result in even higher-quality, more cost-effective design solutions.

The rise in mobile and cloud technology has also made it possible to design any time, anywhere.

Cloud-based design and analysis deliver greater project clarity earlier in the design process.



Air flow simulation for airport walkway as part of a terminal expansion project.

Image courtesy Johnson, Mirmiran & Thompson (JMT)

Mobility and collaboration

Connecting diverse and distributed teams to the project requires data continuity: consistently accurate data that is accessible at any time, by anyone, working anywhere.

Using BIM, the information inherent in the model provides the foundation for today's web-based and mobile collaboration tools, with a model-centric approach to better coordinate large, diverse, and distributed team workflows and keep projects on course.

Furthermore, the use of mobile devices in the field vastly increases project efficiency during construction. Using a mobile tablet device (e.g. an iPad) to instantly check current model details is considerably faster and more effective than rooting through plan sheets in the site trailer.

"Why exactly is your project team in the trailer again?"

Overheard at the Engineering News-Record's (ENR) FutureTech Conference in San Francisco

Project controls

Reliable visibility across all aspects of the project is necessary in order to oversee and report on the execution of project goals. With a model-centric process, data remains coordinated and consistent throughout the project, connecting schedules and budgets with reality to better assess risk and status.

BIM scheduling tools are being used on large project sites, and can be viewed as ‘4D’ visualisations of project plans. If a crane needs to be in place on a certain date, the ‘4D’ visualisation can be fast-forwarded to that date to see if necessary working areas are clear or obstructed. This methodology is essentially an extension of existing interference and clash detection tools that will continue to evolve.

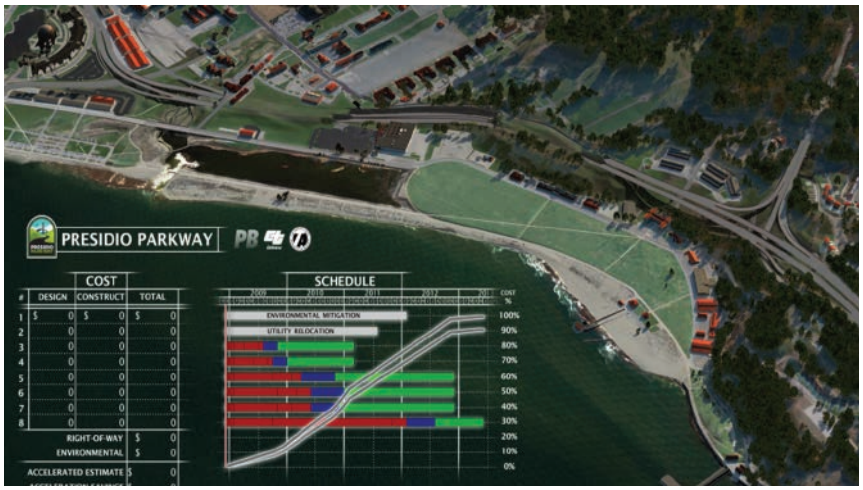
In addition, visualisations can help to calculate the associated cost impacts (5D) of design options in real time, as well as analyse and validate sustainability impact (6D).

There is considerable will among large, established makers of enterprise software to tie their solutions to BIM in support of other mission-critical operations such as procurement, resource deployment, and estimation. Most already have second- or third-generation entrants in the field.

As owners and their consultants develop and

use intelligent models to drive efficiencies, it is a logical next step to connect this process with work management systems.

Greater value is realised when BIM is used “beyond design” in order to better manage the delivered assets.



A model-based project dashboard enables more complete project clarity at any point in time.

Generation Next

Closing the skills gap through technology

By the year 2020, an entire generation will have grown up in a primarily digital world. While not a technology per se, "millenials" will help drive the business transformation that technology makes possible. They have been described as "digital natives" and are connected, content-centric, community-oriented, and always clicking. By some accounts, this group (born between 1979 and 1995) will comprise 40 percent of the workforce within the next decade – and they will be charged with solving some very big and complex problems.

"Engineer employers are projected to need 1.82 million people with engineering skills from 2012 – 2022, this means we will need double the number of engineering apprentices and graduates entering the industry."

ICE's Manifesto
for Infrastructure 2015

Attracting and retaining a younger, skilled workforce has become increasingly critical, especially in the engineering ecosystems where the majority of experienced workers are approaching retirement age. To do so successfully, the approach taken to pursue this up-and-coming workforce must change.

"There is still a big role for the industry to play here when it comes to inspiring the next generations."

Mike Westlake
Education, Autodesk

Technological advances are opening up new career possibilities that might not have existed years ago, potentially appealing to a generation more interested and skilled in technology than previous ones.

Construction needs to adopt the level of technology and modern working practices that are prevalent in other industries to attract young people to the industry. BIM technology will help engage young people and attract them to construction.

Modern model-based design applications, which use visualisation tools that were developed for the gaming industry, provide an environment that is much more familiar and stimulating for the millennial generation than 2D CAD drawings. Cloud computing and collaboration platforms make the process of planning and designing infrastructure more intuitive, social, and immediate.

With rules-based design and documentation, BIM can help to capture the knowledge of experienced workers and transfer it to Generation Next, while maintaining high rates of productivity.

"The goal: to upskill our existing workforce and grow a talent pool of engineers to meet our future infrastructure needs."

ICE's Manifesto for Infrastructure 2015

"Generation Next" will use 3D model-based technologies to solve the world's most challenging infrastructure needs.

BIM Mandates

Intelligent models and handover data will be required on centrally-funded Public Sector projects in England by spring 2016. Exposure levels vary, but this is a risk area for many UK organisations.

Available technology help address the challenges and opportunities that BIM brings.