BUILD USA

PRESENTS

CDE, BIM & BIG DATA

White Paper Two

Sponsored By: SYNTECGROUP

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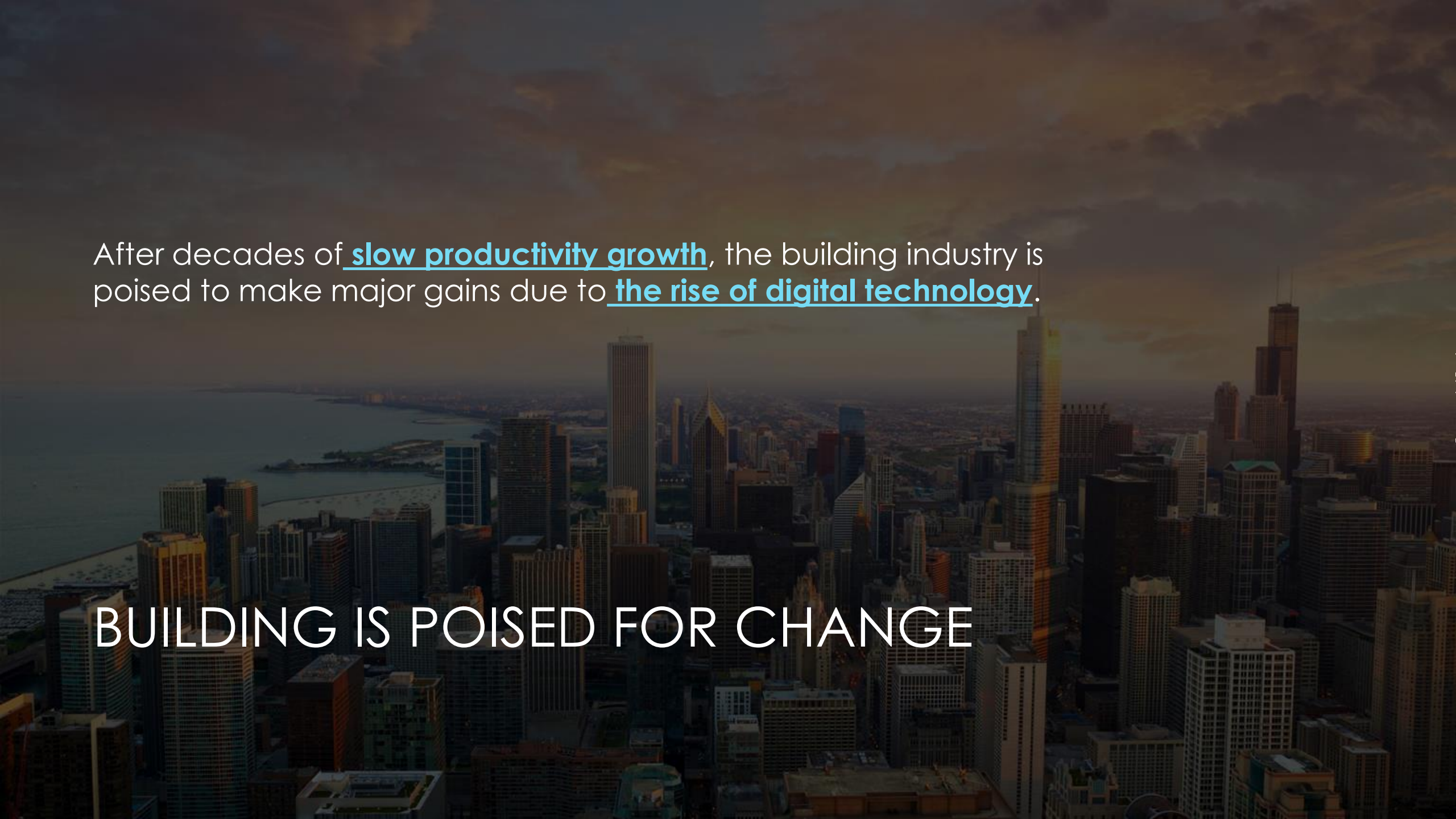
EXECUTIVE SUMMARY

Construction will soon be characterized by connected systems of sensors, intelligent machines, mobile devices, and advanced software applications, all capable of being integrated on a cloud-based collaborative platform, represented virtually by a BIM Model and intelligently analyzed by big data analytics.



After decades of **slow productivity growth**, the building industry is poised to make major gains due to **the rise of digital technology**.

BUILDING IS POISED FOR CHANGE

A GENERAL INTRODUCTION

Key drivers to the industry's future transformation.

CURRENT HORIZON

Think!

Data generated by the building process & captured by connected systems can be structured and shared within a CDE, represented virtually by a BIM model,and shared within a CDE, & intelligently analyzed by big data analytics.

Three key drivers of the industry's ongoing digital transformation:

- Common Data Environment CDE
- Building Information Modeling (BIM)
- Big Data Analytics

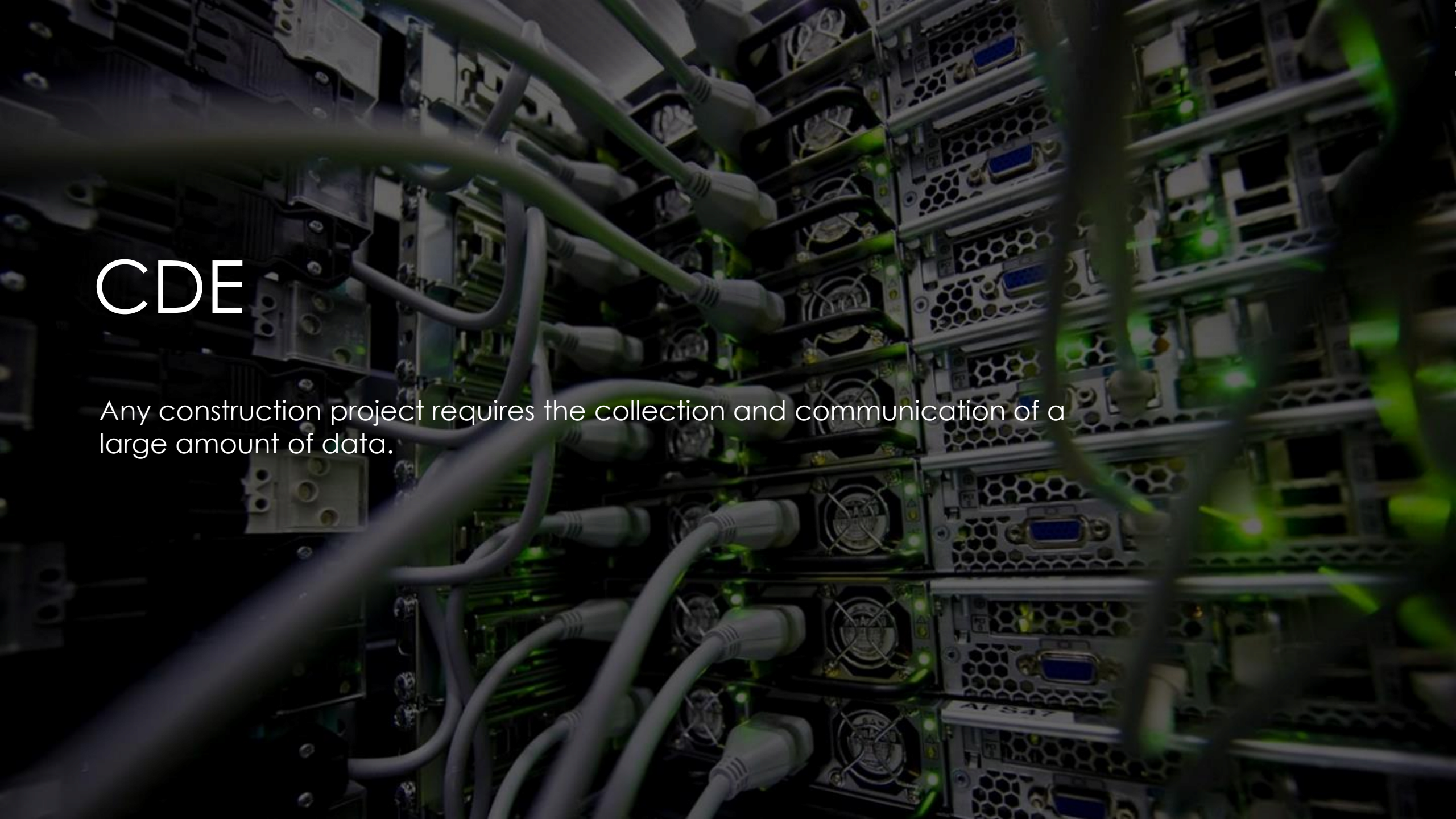
The Pros of These 3 Key Drivers:

- *Boost productivity*
- *Manage complexity*
- *Reduce project delays and cost overruns*
- *Enhance safety and quality*

FUTURE HORIZONS

Construction will soon be capable of being integrated on a **cloud-based collaborative platform** which project stakeholders can use to coordinate and communicate information, the platform will soon be populated with information created by:

- Connected Systems of Sensors
- Intelligent & Autonomous Machines
- Artificial Intelligence
- Mobile Devices
- Advanced Software Applications



CDE

Any construction project requires the collection and communication of a large amount of data.

Many project teams have difficulty dealing with all this data because they lack an effective data management system.

Poor data management can lead to cost overruns, scheduling delays, errors, rework, and other negative outcomes.

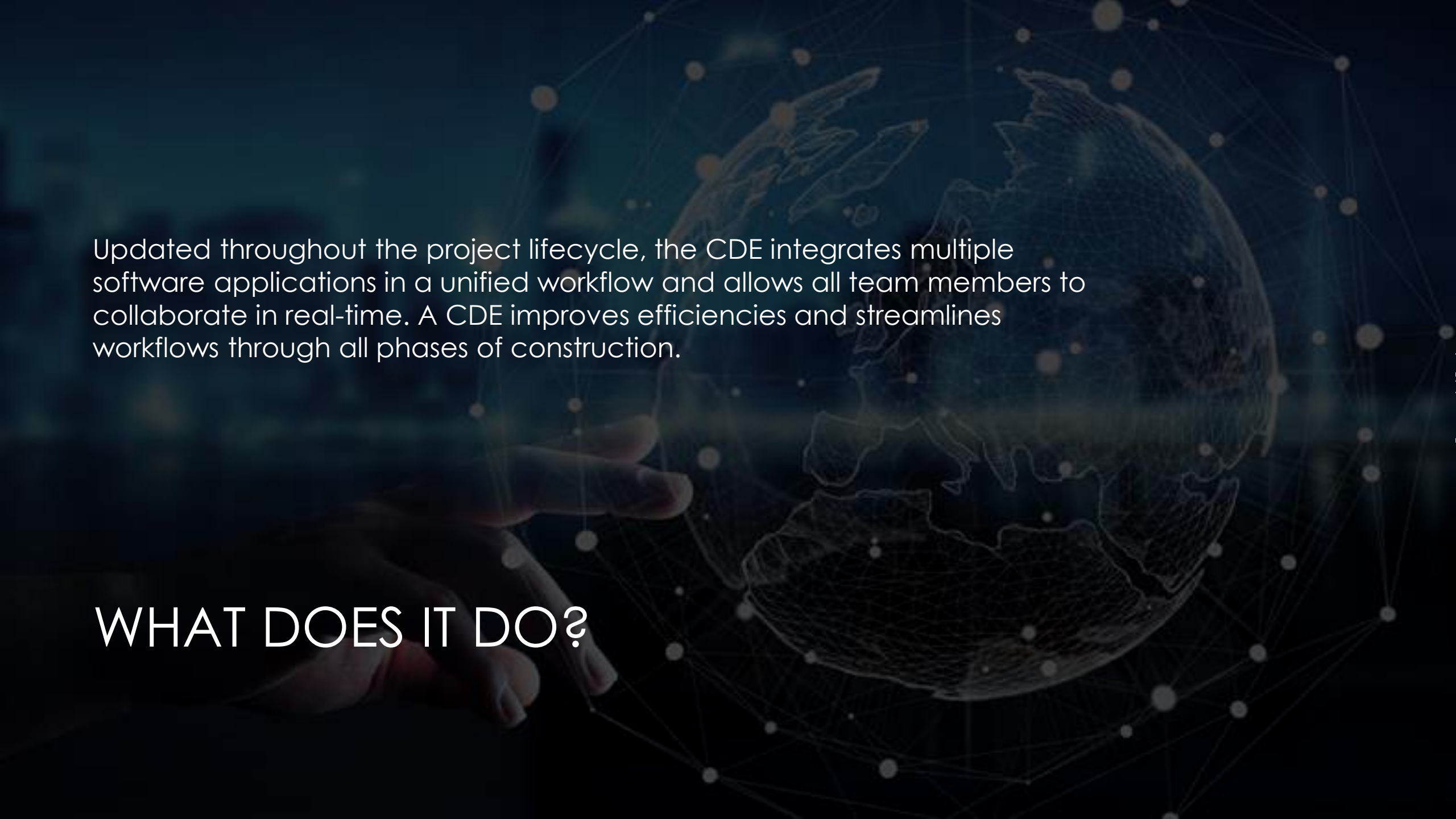
A common data environment (CDE) provides a powerful **solution** for structuring and sharing all project data and sharing it among all project participants.

BACKGROUND

SO, WHAT IS IT?

The project always exists in one of two places; Either physically on site, or digitally within the CDE

A CDE is a cloud-based digital platform that functions as a central repository for all project data. In addition to BIM data, this includes bid documents, contracts, registers, reports, schedules, specifications, and more…

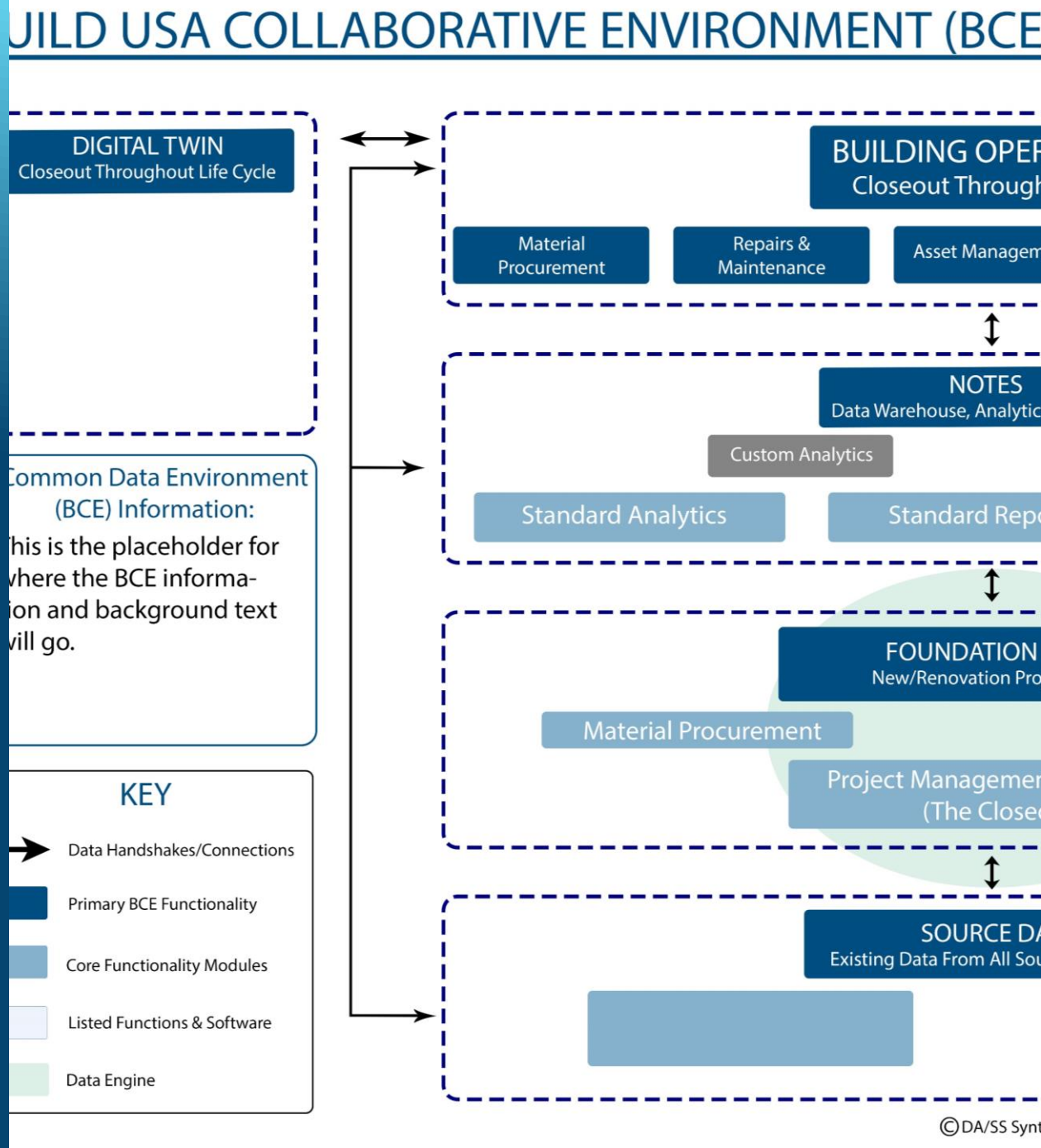


Updated throughout the project lifecycle, the CDE integrates multiple software applications in a unified workflow and allows all team members to collaborate in real-time. A CDE improves efficiencies and streamlines workflows through all phases of construction.

WHAT DOES IT DO?

CDE ORGANIZATION

Organizing a CDE depends upon setting up effective standards, workflows, and templates.



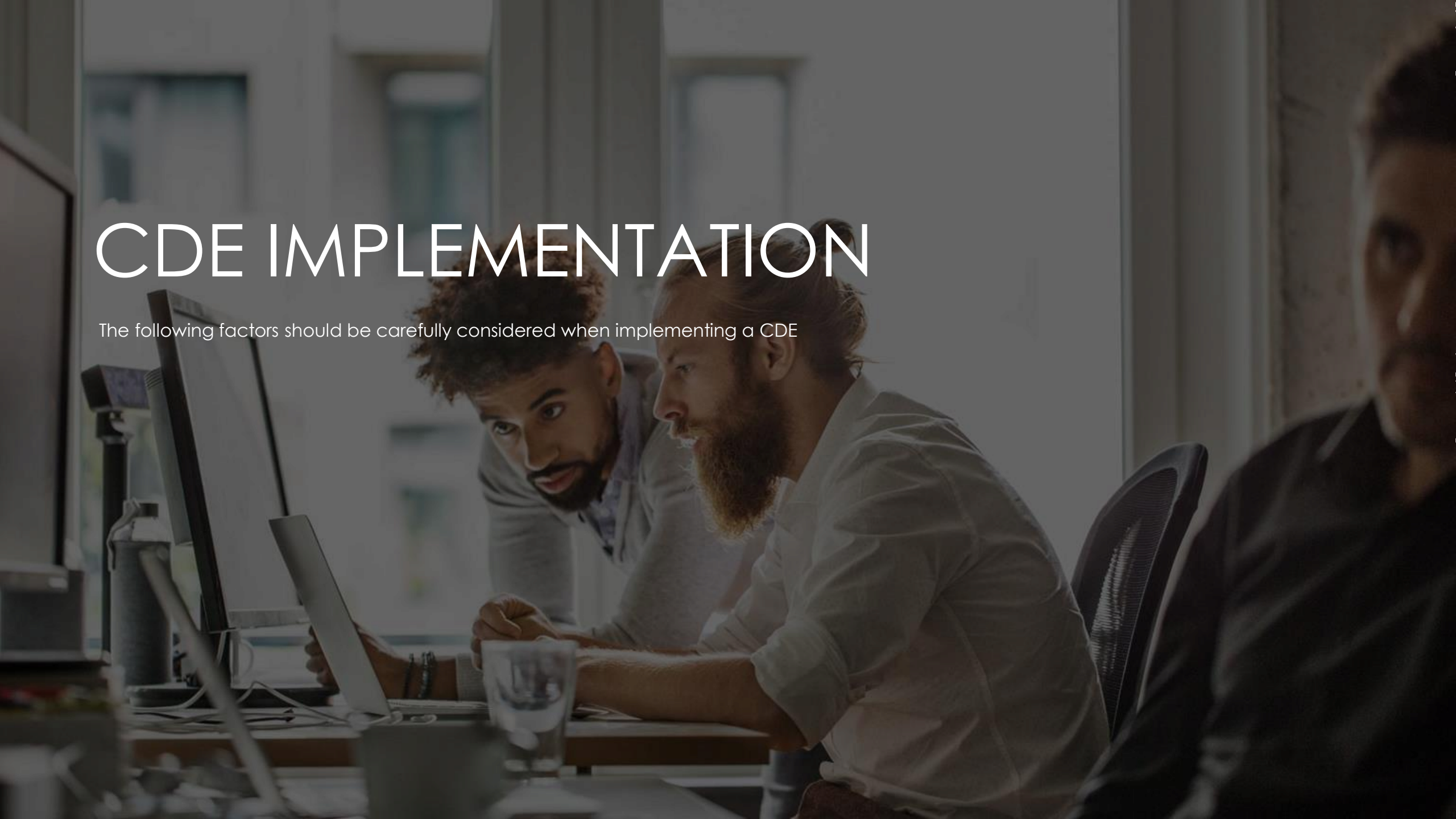
STANDARDS WORKFLOWS AND TEMPLATES!

What does this mean and how do these three concepts drive data?

1. **Standards –** Developing consistent standards for data within the CDE is vital to creating a framework for success. All project participants should abide by the chosen standards.

2. **Workflows –** Workflows are pathways that determine the overall movement of data within the CDE, and the specific direction of data transfers ("handshakes") between different software platforms. Well designed workflows are critical to any CDE solution.

3. **Templates –** Templates define how data is structured and shared within a CDE. Effective templates optimize performance within each software platform and enable seamless data sharing across platforms.



CDE IMPLEMENTATION

The following factors should be carefully considered when implementing a CDE

PRIMARY FACTORS WHEN IMPLEMENTING CDE

1. **Platform –** A CDE should provide an open platform that integrates with existing software applications and is compatible with current systems and processes. Further, a CDE can facilitate future technologies such as machine learning or AI solutions.

2. **People –** Skilled people are necessary to implement and support best practices for operating a CDE. Appointing an information manager can help ensure the best outcome.

3. **Buy-in –** Implementing an effective CDE may prove difficult without buy-in from key stakeholders. Running a pilot program to showcase the CDE's capabilities can help win over skeptics.

4. **Rollout –** Implementing a new technology at scale is a challenge for any organization. Develop a detailed roadmap for a multi-stage rollout in advance of introducing a CDE.

4 BENEFITS OF CDE'S

PRIMARY BENEFIT #1

Enhances collaboration:

A CDE allows all project team members to access the most current information from any location and at any time. This facilitates teamwork and promotes a collaborative culture.

BENEFIT #2

Creates a single source of truth:

The CDE ensures a single source of truth for all project participants. Connecting project teams and project data in a unified environment leads to better decision-making. It also reduces errors, delays, and redundancies. Further, with all versions of all project data stored in a single place, no data is lost.

BENEFIT #3

Ensures data transfer:

During the course of a project, data must be transferred from one project phase to another and from one team to another. Data is often compromised at handover points due to incompatibilities between files or applications, manual errors, or other issues. A CDE ensures successful data transfer across project phases.

BENEFIT #4

Strengthens security:

A CDE stores data in a highly secure environment. It provides a full audit trail of the built asset and allows project managers to maintain strict control over who can access project content.

BIM

BIM BACKGROUND

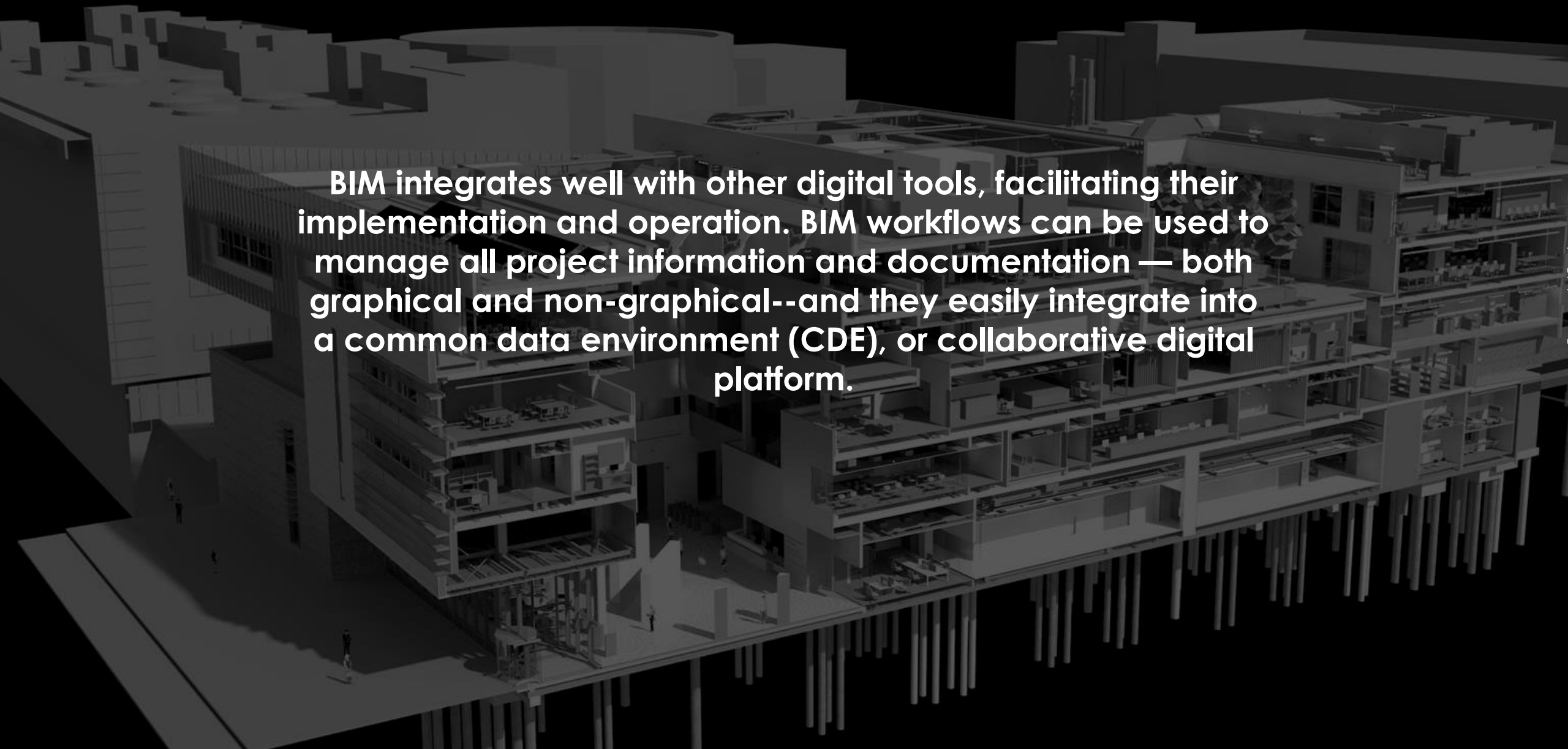
BIM provides a digital representation of all the elements in a building along with their physical, functional, and commercial characteristics.

It enables information to be shared accurately and consistently among project stakeholders throughout all three phases of an asset's life cycle.

As the successor to traditional computer-aided design (3-D CAD), BIM stores and provides:

- Object Data **(3-D)**
- Shared Information on Scheduling **(4-D)**
- Cost **(5-D)**
- Sustainability **(6-D)**
- Operations & Maintenance **(7-D)**

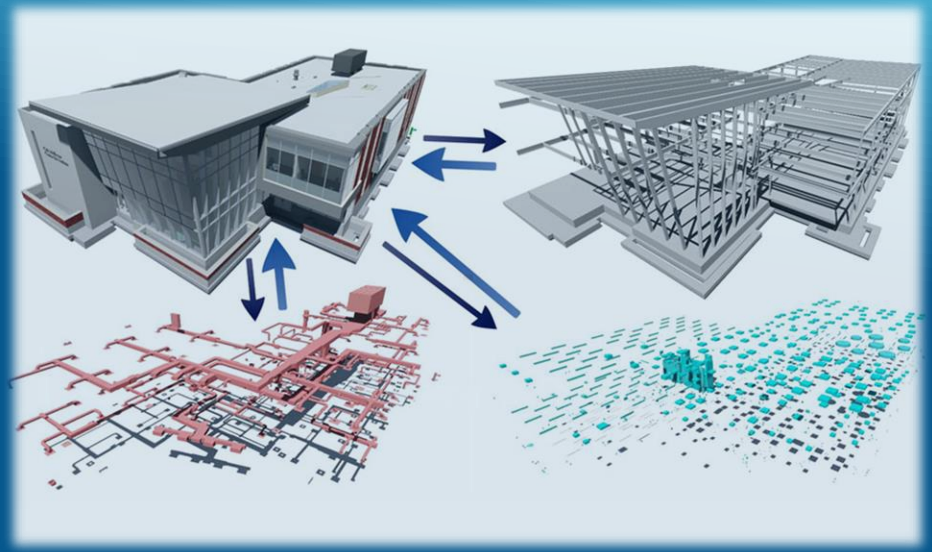
BIM – A POWERFUL TOOL FOR PROJECT MANAGERS



BIM integrates well with other digital tools, facilitating their implementation and operation. BIM workflows can be used to manage all project information and documentation — both graphical and non-graphical--and they easily integrate into a common data environment (CDE), or collaborative digital platform.

BIM – SIMPLE MARKET DATA

McKinsey & Company found that 75% of project leaders who adopted BIM reported a positive return on their investments, shorter project life cycles, and **savings** on general paperwork and material costs.



Boston Consulting Group estimates that, by **2025**, BIM will have advanced enough in the building industry to generate productivity gains of **15% to 25%!**

BIM BENEFITS

BIM serves as one of the primary data sources for integrated design, modeling, planning, and data-sharing.

Increase Collaboration and Communication

Total Life Cycle Operation

Support Digital Technologies

Manage Subcontractors and Suppliers

Enhance Design

Facilitate O&M

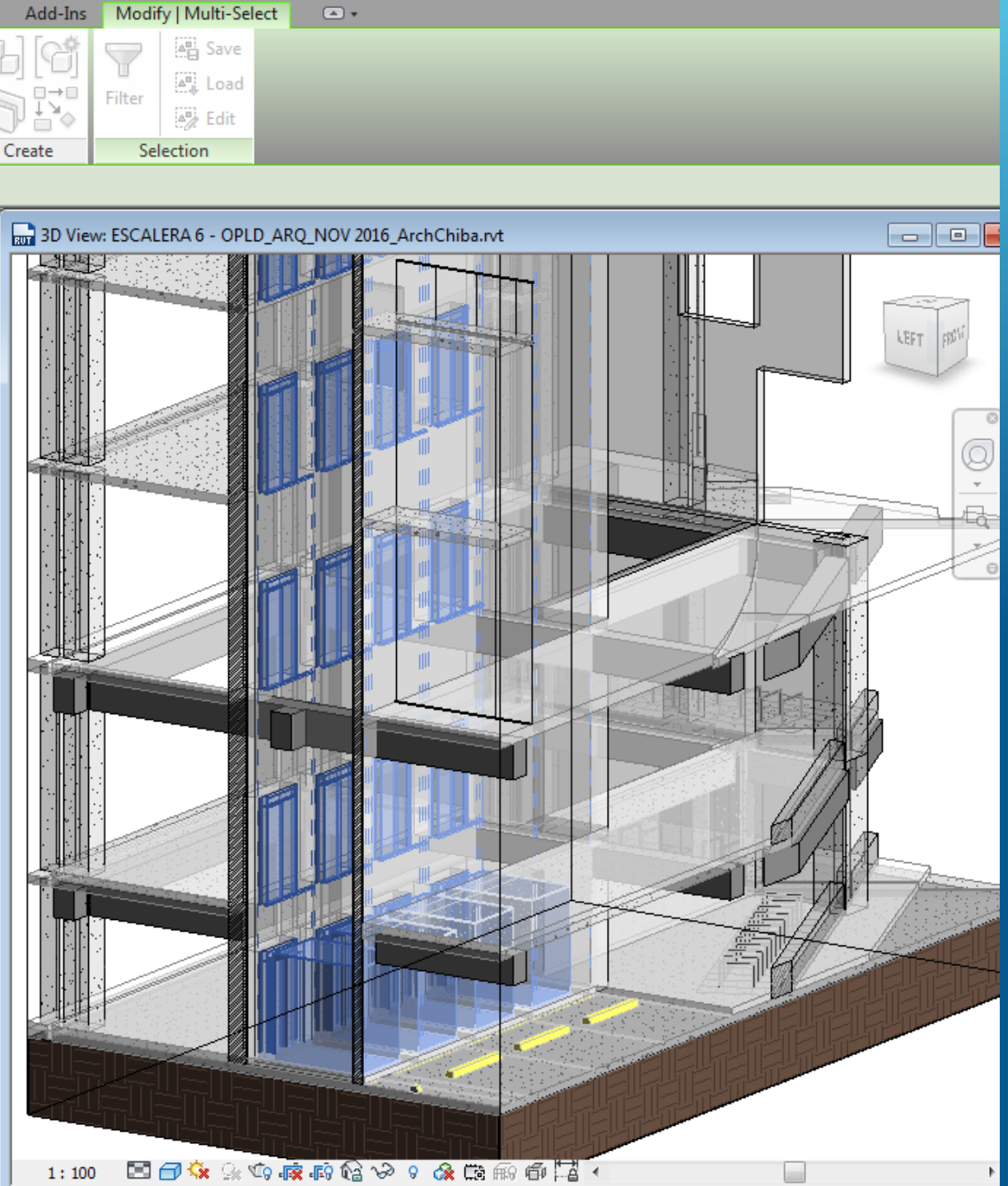
Ongoing Renovations/Additions

BIM'S SUPPORTING BENEFITS

The numerous benefits provided to stakeholders across the value chain.

INCREASE COLLABORATION AND COMMUNICATION

BIM facilitates collaboration and transparency among all project stakeholders. All stakeholders can contribute information to and extract information from the central model. This connectivity enables large efficiency gains.

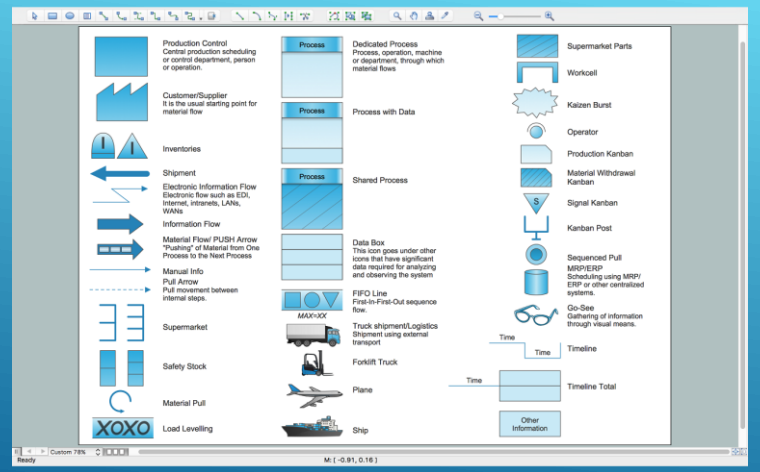


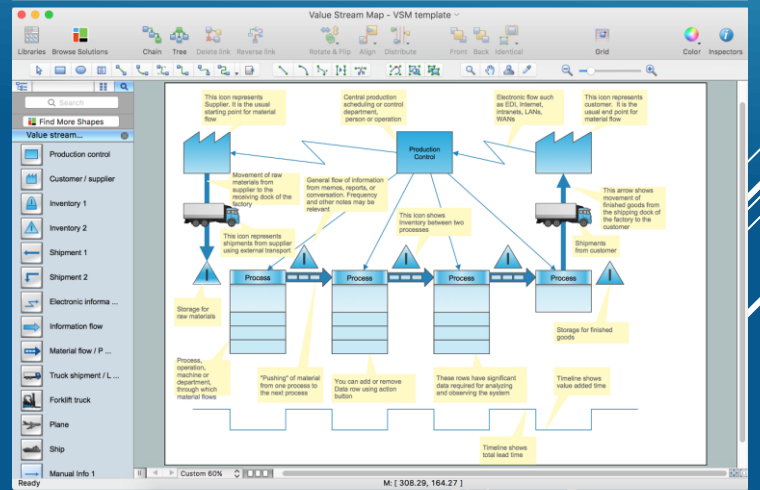
LIFE CYCLE OPERATION

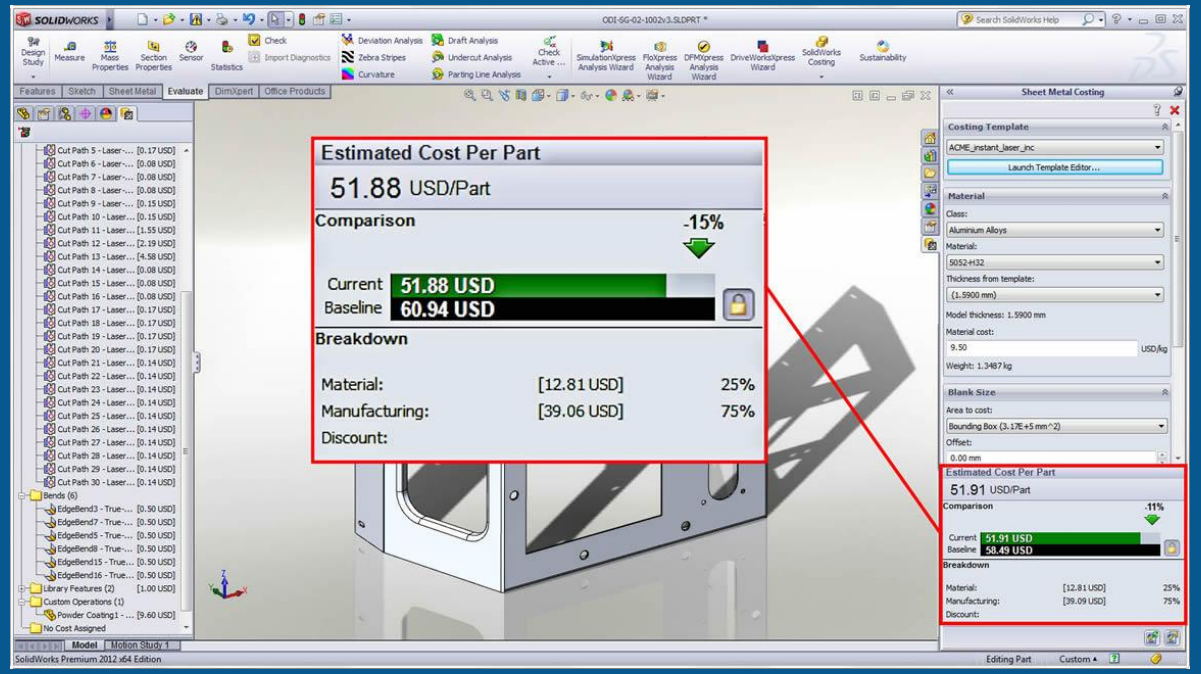
By providing a lifelong view of building projects, BIM, in coordination with partner software, produces a continuous accumulation of knowledge by enabling a seamless flow of information across project phases, from design to construction to O&M.

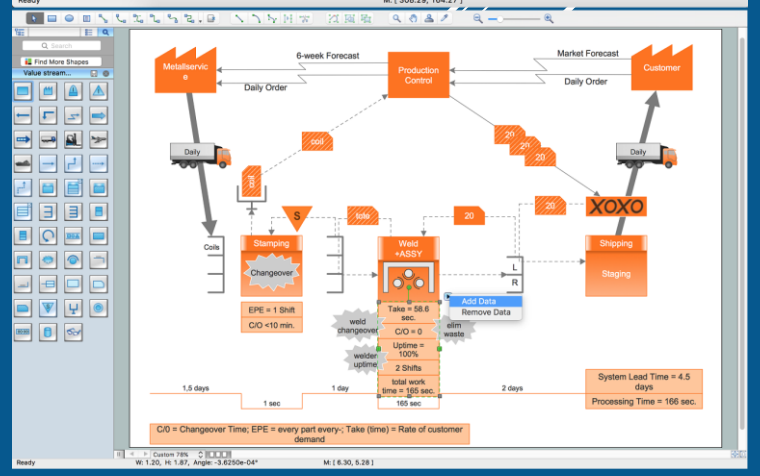
SUPPORT DIGITAL TECHNOLOGIES

BIM supports several partner software applications and data systems central to digitization: analytics, simulation, and value-engineering software in the design phase; project management tools in the build phase; and asset-management systems in the operations phase.





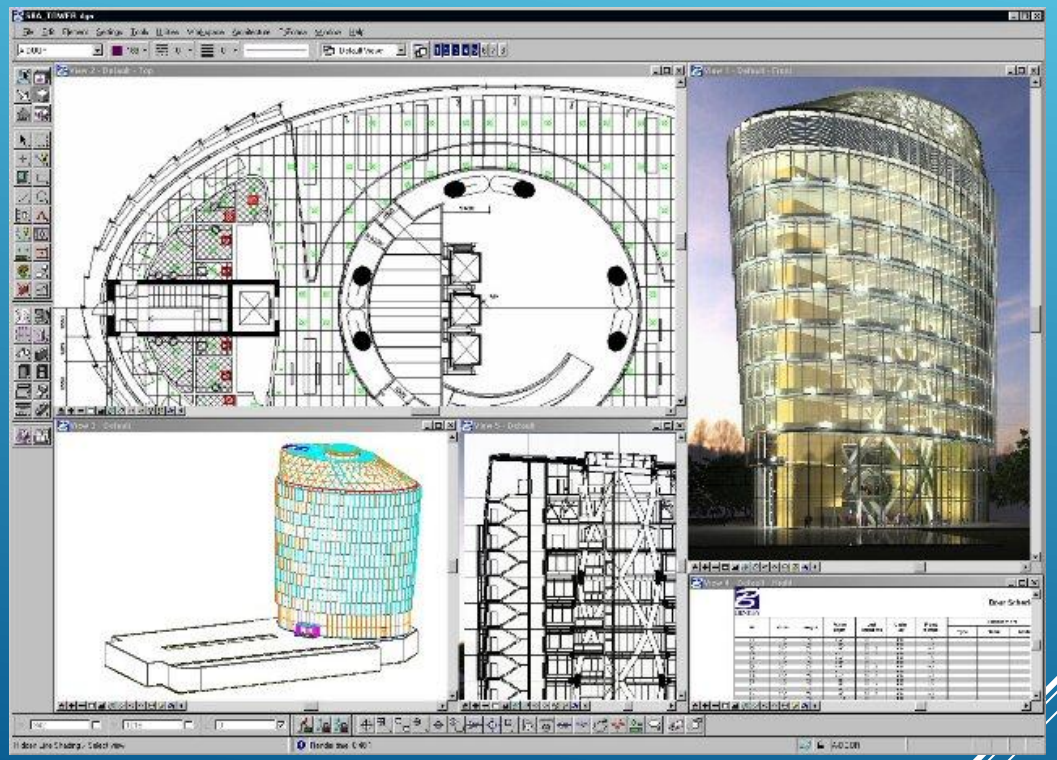




MANAGE SUBCONTRACTORS AND SUPPLIERS

Using BIM and partner software applications, subcontractors and suppliers can be informed of scope and design changes in real time, thus reducing the number of requests for information. Tendering processes become more transparent, seamless, and efficient due to accurate information derived from the building model and then shared with potential bidders.

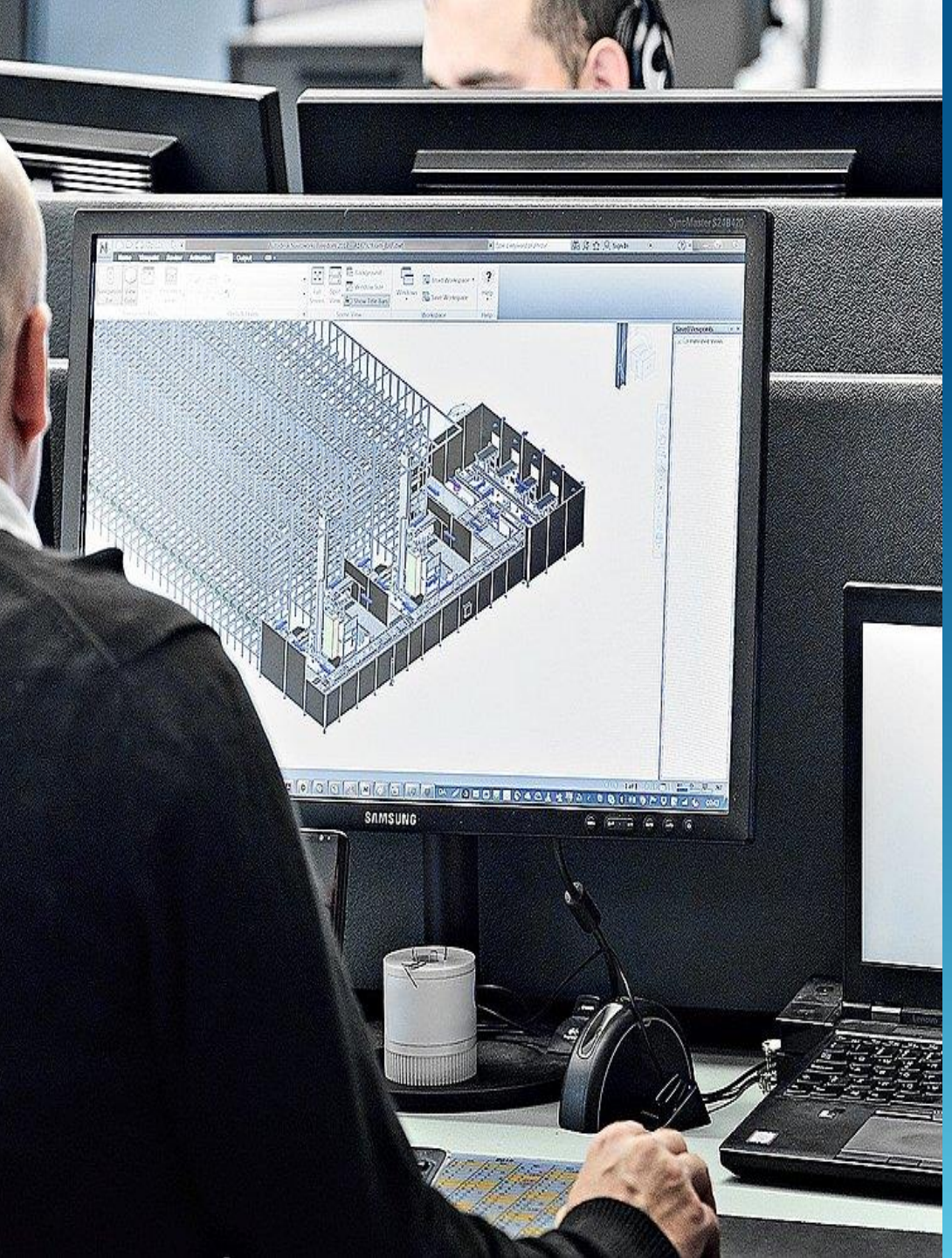
ENHANCE DESIGN



BIM, in coordination with partner software applications, can identify potential design clashes and constructability issues, thereby avoiding costly corrective changes and rework. Design elements can be checked for compliance with regulatory requirements. Integrated workflows accelerate the design phase.

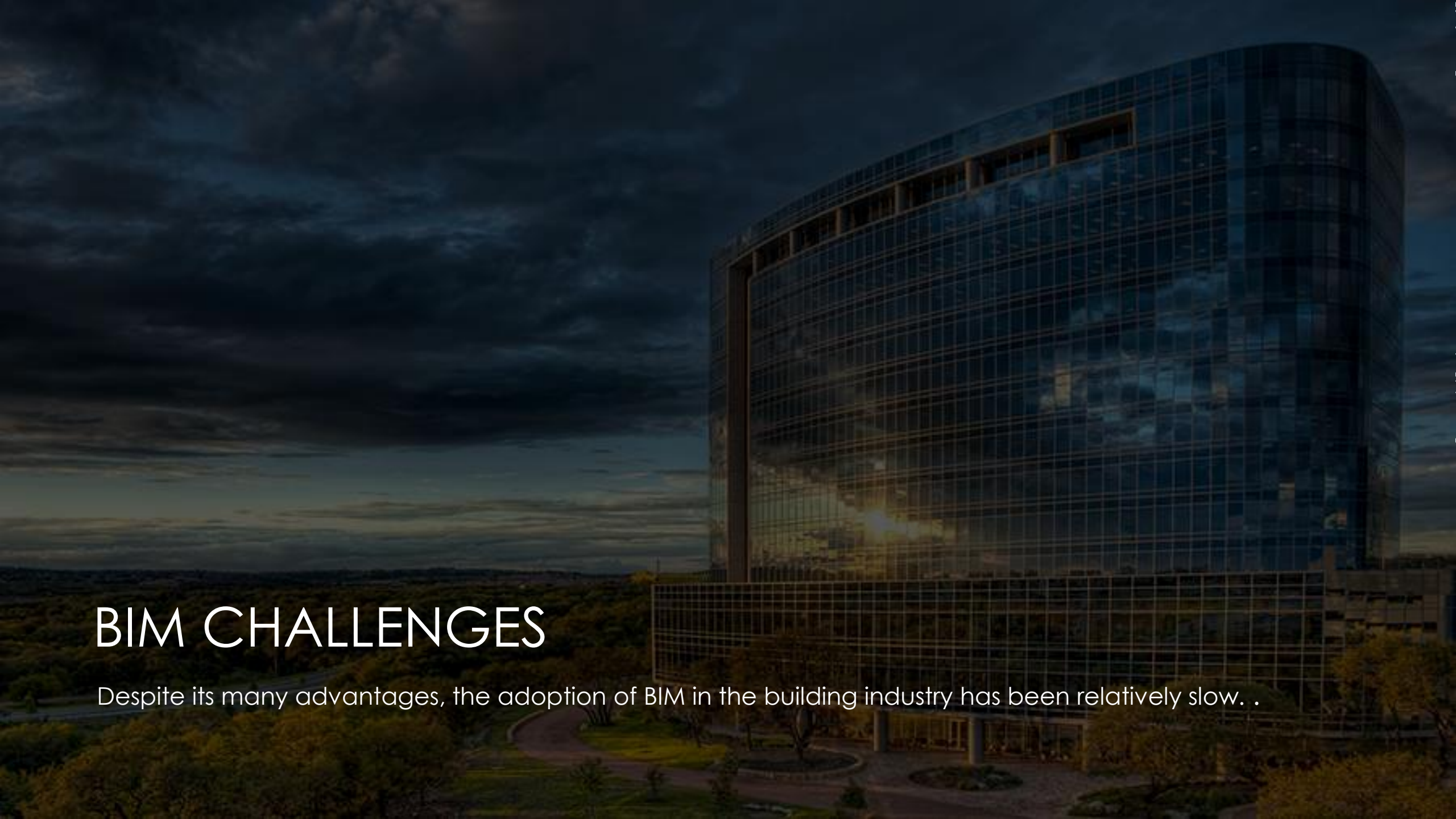
FACILITATE O&M

BIM, in coordination with partner software applications, allows companies to store, maintain, and access spatial, technical and warranty data about an asset. This makes commissioning and O&M activities more efficient.



RENOVATIONS/ADDITIONS

BIM facilitates the planning of major repairs, retrofits, and expansions.



BIM CHALLENGES

Despite its many advantages, the adoption of BIM in the building industry has been relatively slow. .

BIM CHALLENGES

Despite its many advantages, the adoption of BIM in the building industry has been relatively slow. According to **the ConTech report for 2019:**

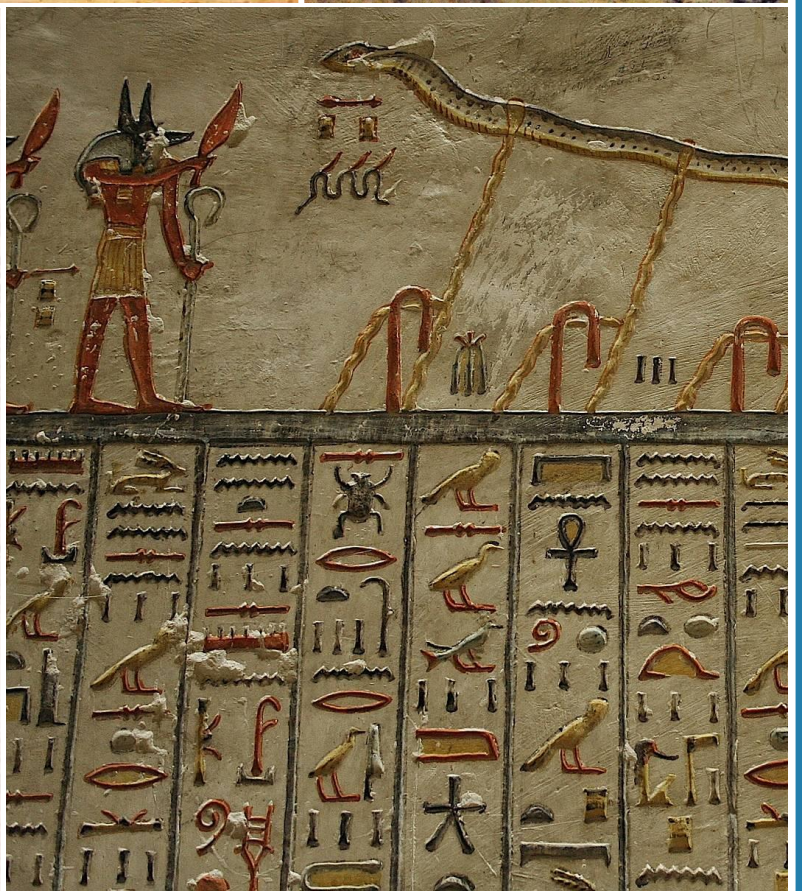
55% of construction firms currently use BIM software

17.5% do not plan to adopt BIM at all

Many organizations, especially smaller firms, often fail to realize the long-term savings that can result from BIM. What factors are limiting the large-scale adoption of BIM?

BIM'S CHALLENGES

- *Interoperability Issues*
- *Avoiding Standards*
- *Limited Relevancy*
- *Program Limitations*
- *Upfront Investment*
- *Digital Talent*
- *Legacy Thinking*
- *Complexity*

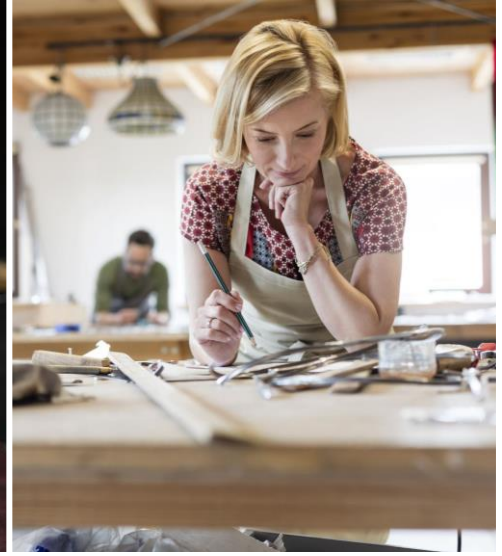


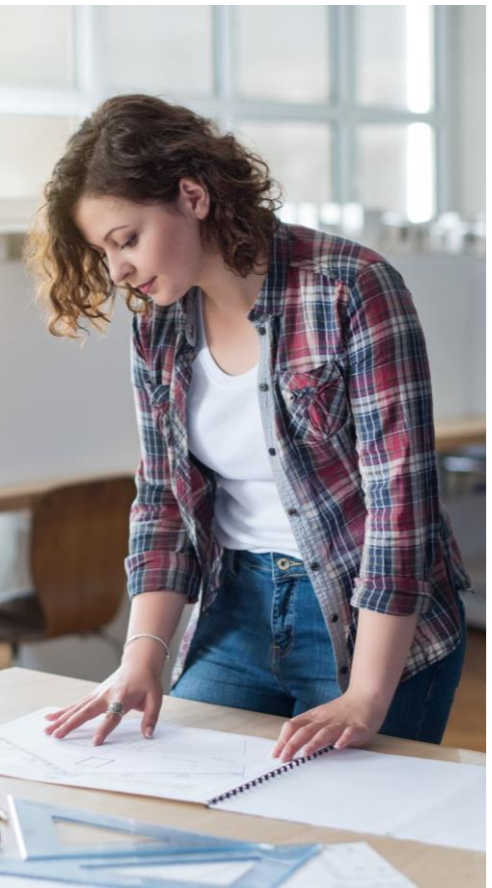
Building projects involve numerous stakeholders. Project data needs to be represented in a common format that enables all stakeholders to share information without obstruction. However, many BIM software programs were originally developed to operate as standalone applications with their own proprietary data structures.

INTEROPERABILITY

STANDARDS

Standards help ensure that overall BIM implementation is sustainable and successful. However, some project coordinators and owners fail to establish and enforce consistent standards, thus creating complications and limiting productivity.



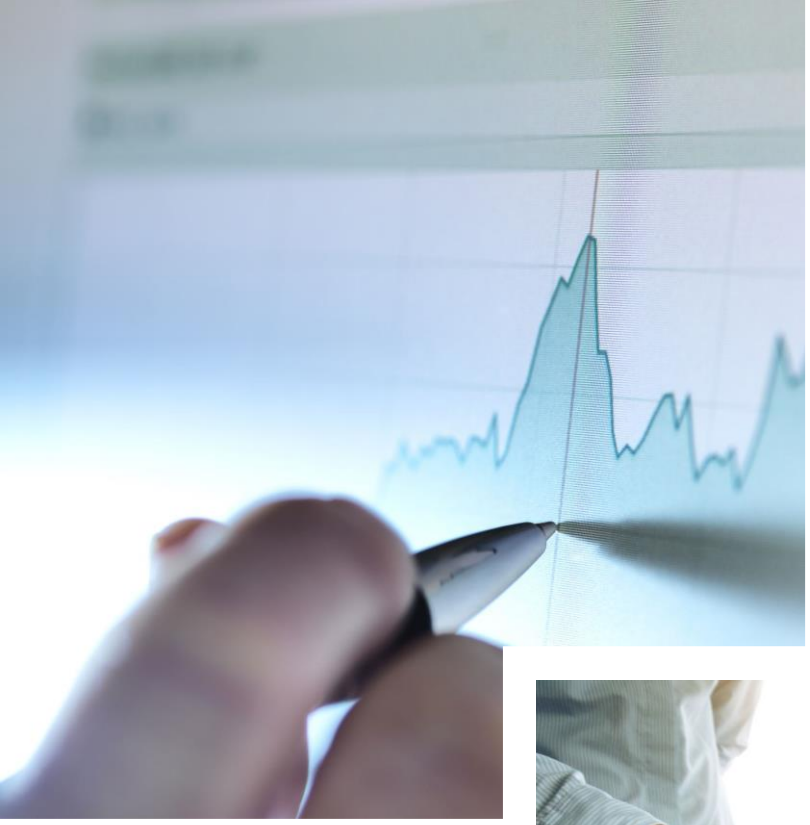


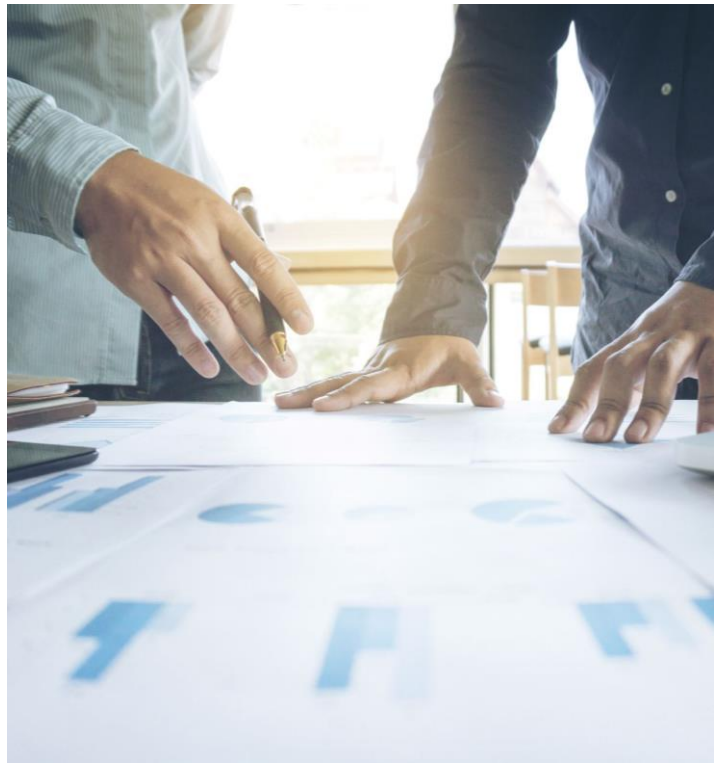
LIMITED RELEVANCY

An important factor limiting the growth of BIM is its slow adoption in small and medium-sized organizations. For some large companies, BIM is a common feature of daily operations. However, **71% of small firms** feel that BIM isn't applicable to their typical project workload.

PROGRAM LIMITATIONS

Many existing BIM applications address only a single phase of an asset's life cycle. As a result, BIM models sometimes require significant revisions to become useful. Moreover, most models focus on design and construction, and neglect O&M. For example, **O&M applications account for only 10 out of 206 commercial applications** listed in an industry database of open source BIM applications.



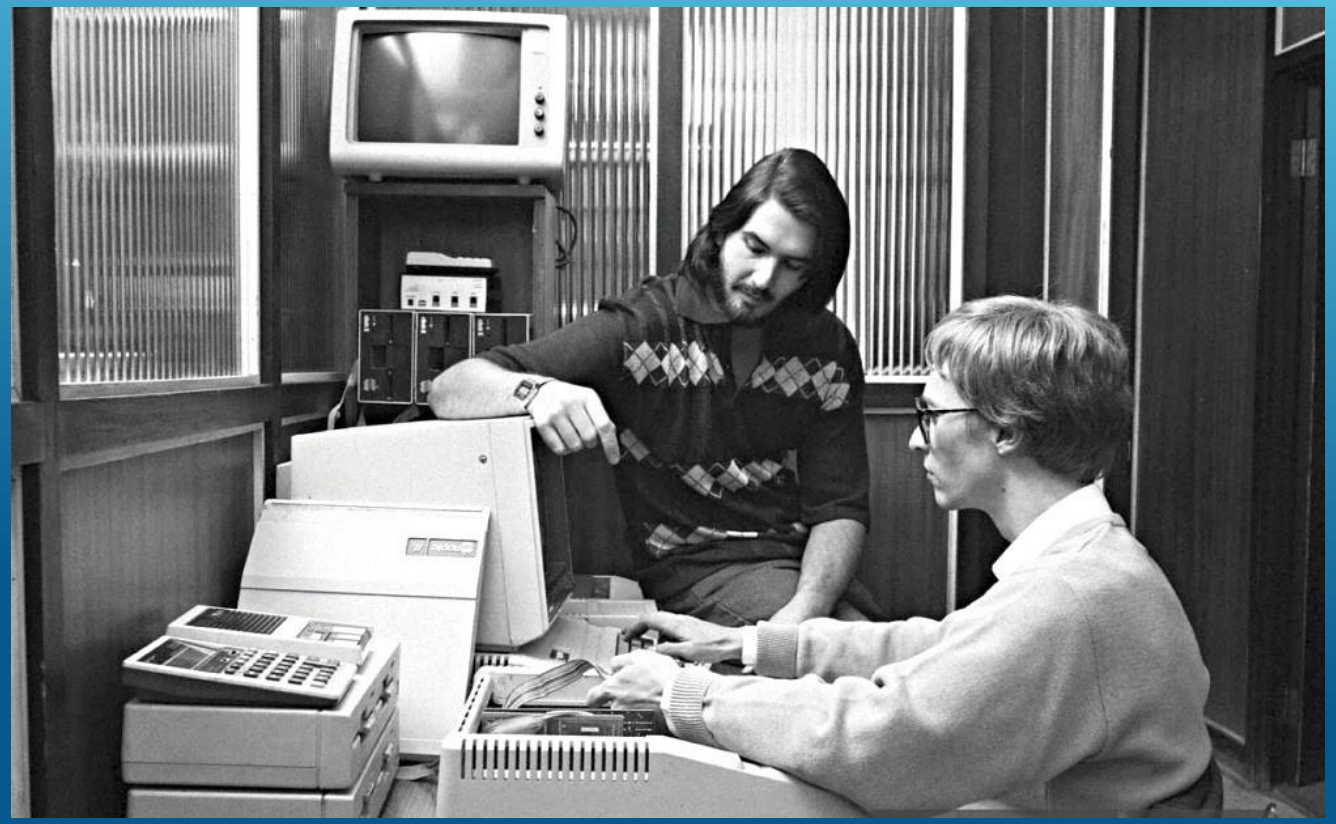


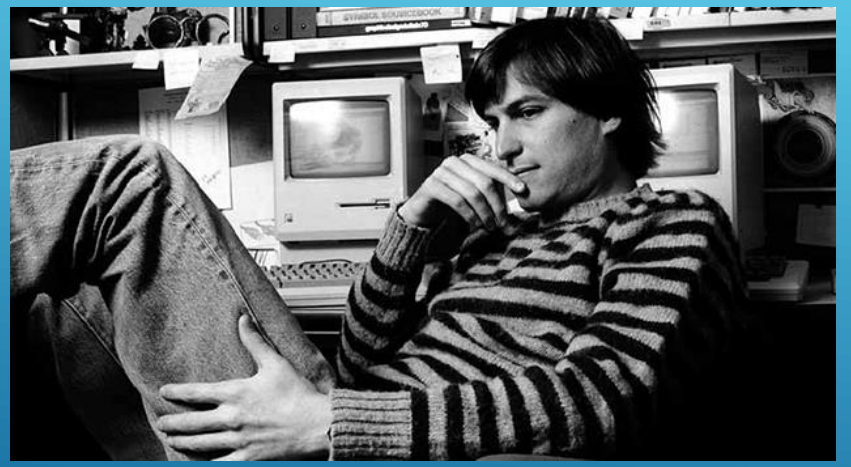
UPFRONT INVESTMENT

Making BIM work requires a substantial effort upfront. In addition to spending money, companies must acquire the relevant know-how, train workers, upgrade IT, set standards, find the right strategic positioning, and align stakeholders. Small and medium-sized companies may struggle to afford the initial investment.

DIGITAL TALENT

Digital Talent. Implementing BIM requires a considerable build-up of expertise and appropriate employee training. It is often difficult for companies in the building industry to attract new **digital talent** with the requisite tech skill set.



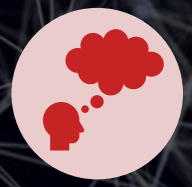


LEGACY THINKING

Decision-makers in the building industry often lack enthusiasm when it comes to adopting new methods and new technologies. Legacy thinking leads to inertia when it comes to implementing BIM.

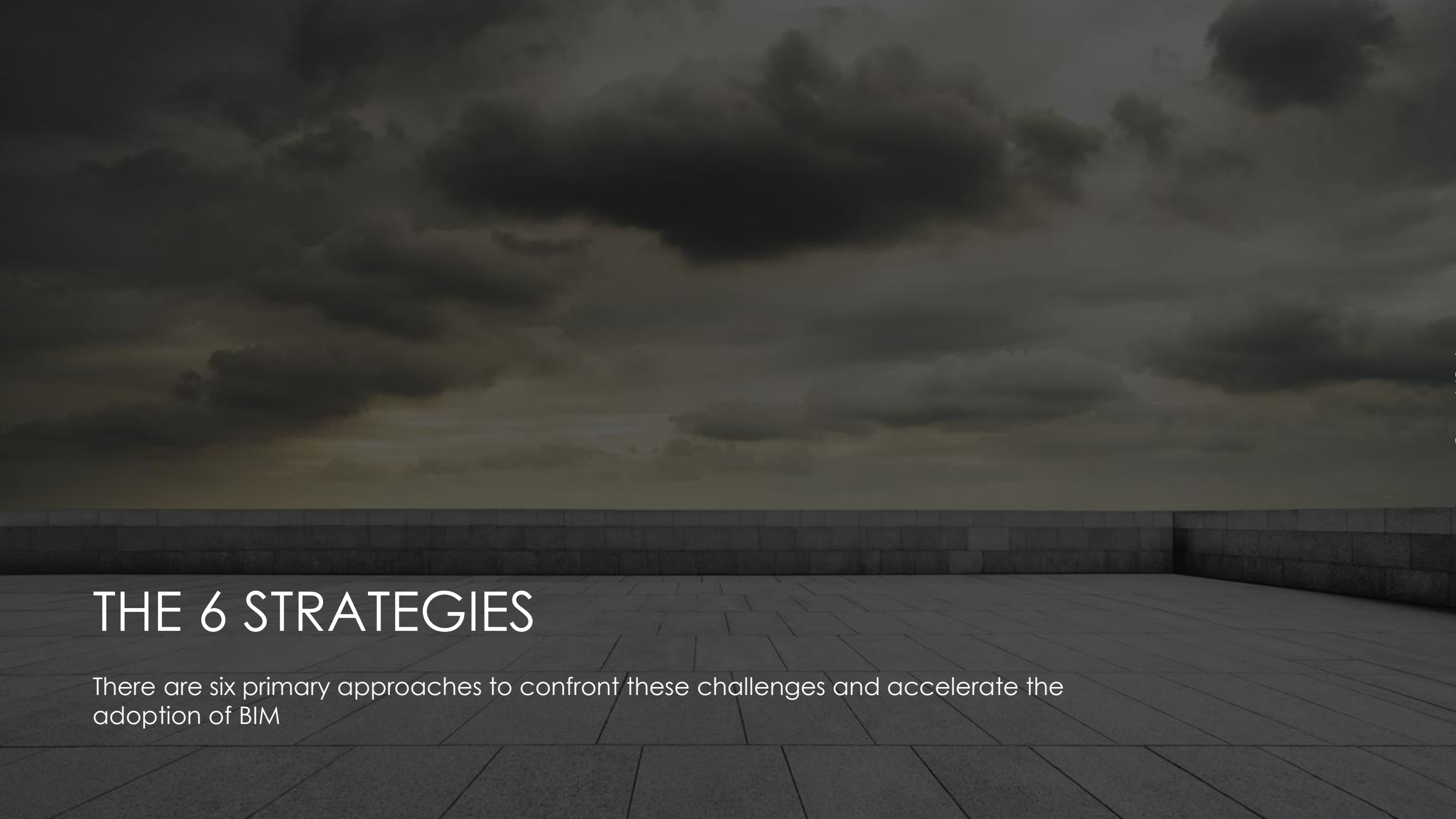
BIM requires a highly trained professional on a powerful workstation in order to realize the benefits as described above.

COMPLEXITY



OUR RECOMMENDATIONS TO CONFRONT THESE CHALLENGES

To confront these challenges, and accelerate the adoption of BIM, companies along the value chain can make use of specific strategies.



THE 6 STRATEGIES

There are six primary approaches to confront these challenges and accelerate the adoption of BIM

THE 6 STRATEGIES

1. ***Invest Upfront –*** To get the full benefit of BIM, project owners and contractors should invest in the requisite software, hardware and IT infrastructure, dedicate resources to BIM implementation, and incorporate its use right from the design stage.
2. ***Increase Knowledge –*** Provide industry players with an understanding of BIM's benefits across the entire lifecycle. Highlight BIM's potential as a long-term value creator rather than a short-term cost factor.
3. ***Increase Collaboration –*** Successful BIM adoption requires a high level of **collaboration among stakeholders**. To this end, companies should strive to establish open data-sharing standards and promote teamwork using integrated contracts.
4. ***Upgrade Workforce –*** Successful adoption also requires a coordinated effort to attract new digital talent to upskill the current workforce.
5. ***Change Mindset –*** Change conservative corporate cultures to support digital innovation.
6. ***Shared Standards, Workflows, and Templates –*** Shared industry standardization, will significantly reduce many of the challenges above.

BIG DATA

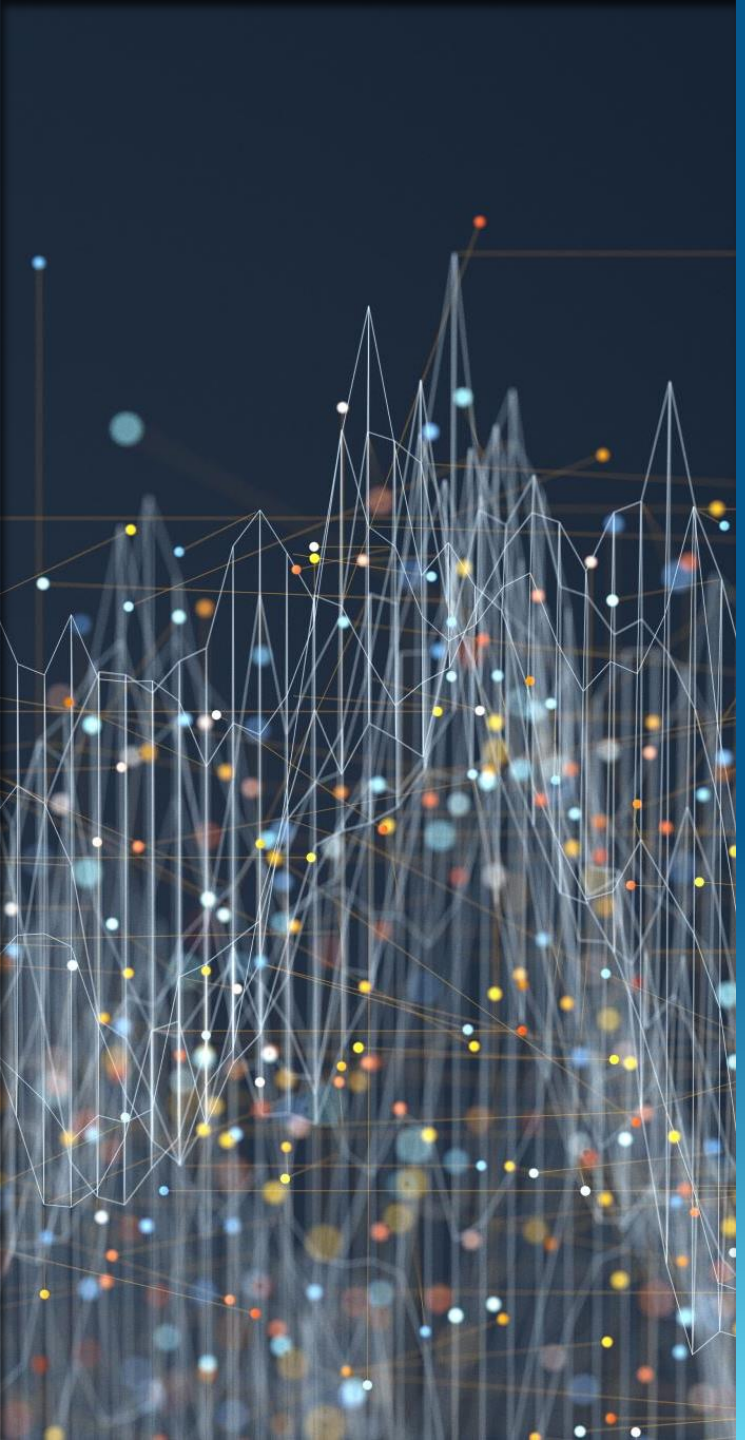
BIG DATA – BACKGROUND

BACKGROUND

The term “big data” refers to data so large and complex that it’s impossible to process using traditional methods.
Big data can come from:

- People
- Computers
- Machines
- Sensors
- Any other type of data-generating device

Big data analytics allows companies to transform the massive quantity of data they produce into actionable insights that **enhance decision-making, optimize operations, and boost project performance.**



However, **most of this data is unstructured**. Traditional information systems are limited in their ability to process unstructured data like free text, printed information, or sensor output. According to **recent estimates**, **less than 0.5%** of all data produced by most construction companies ever gets analyzed.

BIG DATA – "THE DATA"

IN GREATER DETAIL

Real-world big data is made up of masses of inputs that are derived on numerous fronts. Vast amounts of **useful data** serive from sources such as:

- Past & present construction projects
- Design plans
- Existing buildings
- Machinery & equipment
- Material supply chains
- On-site workers
- Wearables
- Smartphones
- Tablets
- Drones
- & much, much more!

THE **BIG** TAKEAWAY

Big data is unique in that it can discover hidden patterns in huge amounts of data. Other methods cannot deal with databases that immense.

BIG DATA BENEFITS

Big data analytics offers potential benefits for all three phases of an asset's life cycle

Design Phase

Construction Phase

Operations Phase

BIG DATA'S BENEFITS

Big data analytics offers potential benefits for all three phases of an asset's life cycle.

Design Phase

Big data -- including building design, modeling and environmental data -- can be used to determine not only what to build, but also the optimal locale for a building. Big data can be analyzed to reveal historical patterns and probabilities of risk to help guide new construction projects and avoid potential pitfalls.

Construction Phase

Sensor data from on-site machines and equipment can be processed to enhance efficiency for active time and downtime, fuel consumption, cost factors, logistics, and environmental impact.

Big data from weather, traffic, and community activity can be analyzed to determine the optimal phasing of a building project. Further, analytics can anticipate problems with ongoing projects, allowing managers to avoid potential delays and cost overruns.

Operations Phase

Sensor data now has an important role to play in the operations phase as well. Big data derived from sensors built into buildings, bridges, and other structures makes it possible to monitor an asset at multiple performance levels.

This allows for better facility management, more efficient energy usage, and improved risk detection.

BIG DATA CHALLENGES

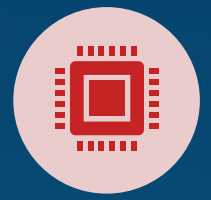
Adopting analytics tools may pose challenges for project-driven businesses in the building industry.

Unstructured Data

Data Integration

Variability

Staff

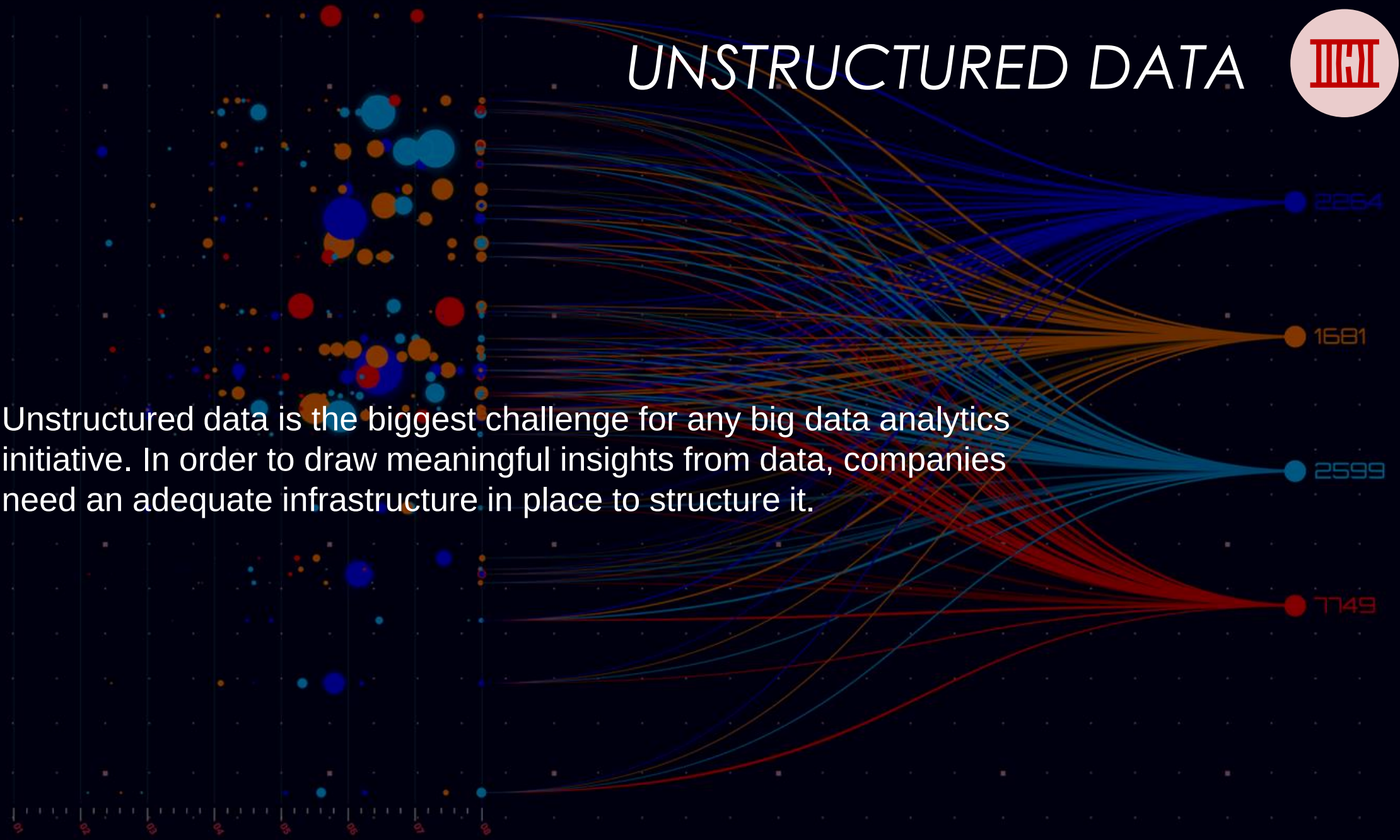


Interoperability

Culture

BIG DATA CHALLENGES

UNSTRUCTURED DATA



Unstructured data is the biggest challenge for any big data analytics initiative. In order to draw meaningful insights from data, companies need an adequate infrastructure in place to structure it.

The conservative culture of the building industry tends to resist change. Traditional companies are often reluctant to embrace data-driven business models.

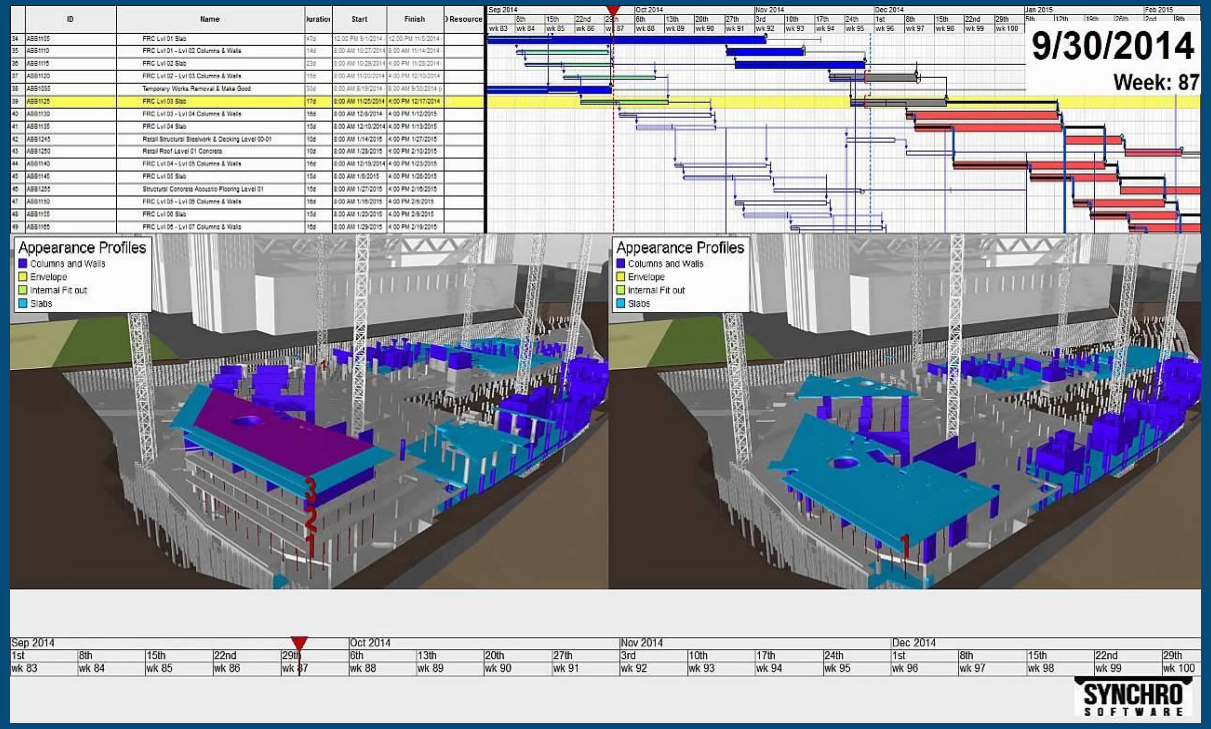
CULTURE

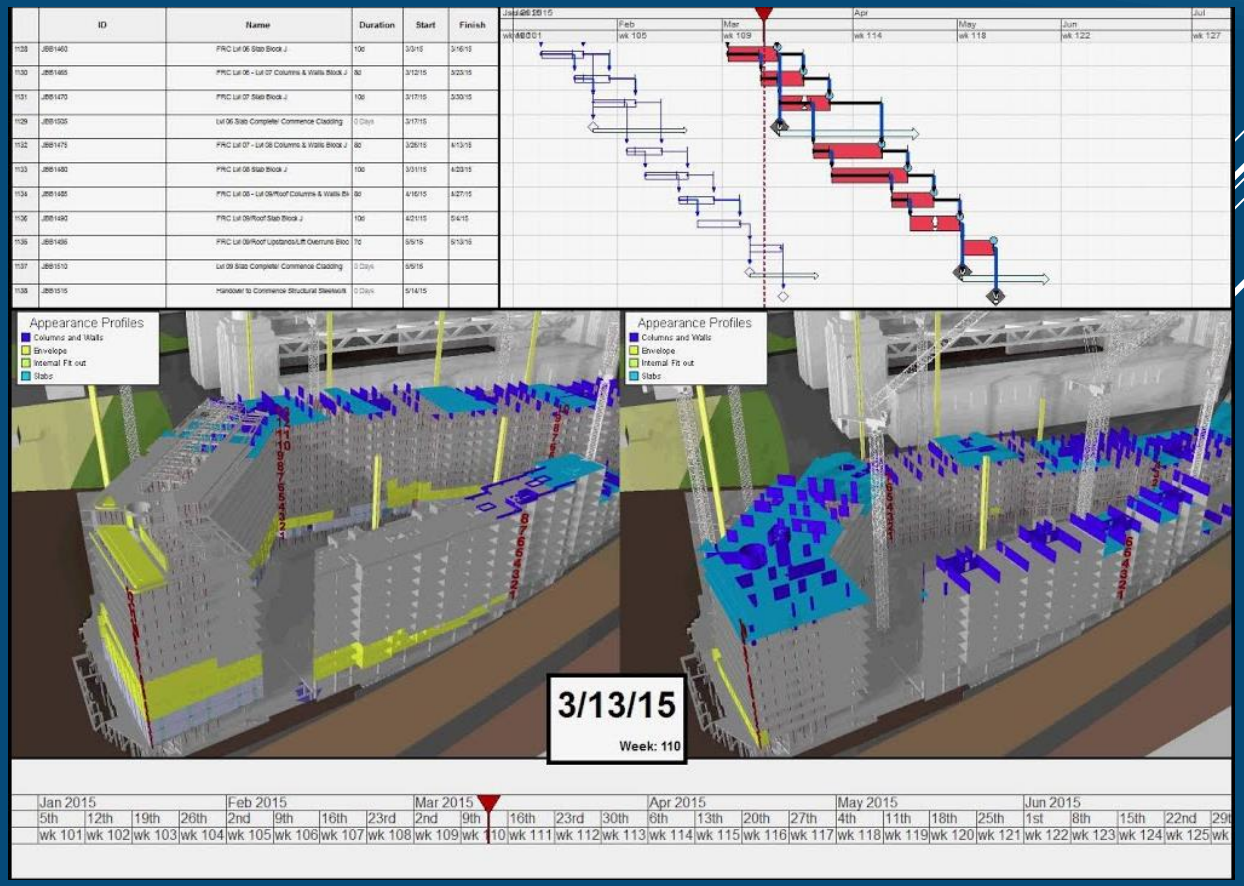
DATA INTEGRATION

Many companies have collected large amounts of data. However, their data is stored in siloed systems and inconsistent formats. The integration of disparate data sources required to implement an analytics solution is often a difficult endeavor.

VARIABILITY

Construction companies face high variability. Progress-tracking systems sometimes change mid-project, and factors such as scale, materials, and subcontractors vary from project to project. This causes inconsistencies in the collected data.



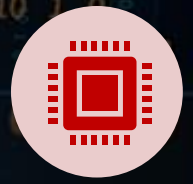


Few companies have data analysts on staff who can take ownership of advanced analytics initiatives.

STAFF

Interoperability issues can arise between software solutions, analytics tools, and data-capturing devices. According to recent **research by FMI**, 30% of companies are currently using applications that do not integrate with one another.

INTEROPERABILITY



INTERPRETING THE CHALLENGE AT SCALE

Understanding how to capitalize on the value contained in big data requires **strategic planning** and a clear vision of your organization's overall goals.

With the above challenges in mind, the first step for companies who want to adopt an analytics solution should be to take stock of their accumulated data and convert it into a form they can digitally analyze.

This one-time, time-intensive process will create a foundation for structuring data going forward.

Second, companies should establish consistent standards for the data they collect in the future. Standards are critical to a successful long-term data analytics strategy.

INTERPRETING THE CHALLENGE

CONCLUSION

BIM – INTEGRATION

The integration of BIM with Big Data in the context of a Common Data Environment (CDE) offers companies and consumers significant long-term benefits.

BIM – ROI

Turning big data into viewable insights via BIM results in enhanced operational efficiency, accelerated project delivery time, reduced costs, and increased profit margins. As shown by a **recent case study**, data-driven BIM can cut construction expenses by **18%** and reduce completion time by up to **12 weeks.**

BIM – ITS VALUE

The ongoing transformation of the building industry will rely increasingly on powerful digital tools such as BIM, CDE's, big data analytics, and **artificial intelligence solutions**. As digital technology penetrates the building industry and all other parts of the economy, extracting value from data will become essential

Companies that embrace data-driven solutions will gain a competitive advantage and emerge as industry leaders. Companies reluctant to invest in the systems and skills necessary to harness the power of their data will be left behind.

A NEW FUTURE

A NEW FUTURE

The adoption of data-driven solutions in the building industry offers benefits for society. These benefits include safer and more efficient project delivery, a more sustainable and resilient built environment, and higher-quality "Optimized" buildings delivered to the market more quickly and at lower costs.

FINALE

Due to the central importance of the built environment in the global economy, and its impact on almost all other industries, insights drawn from data analytics in the construction sector will have far-reaching positive effects.

SOURCES

- The New Age of Engineering and Construction Technology
- Seizing Opportunity in Today's Construction Technology Ecosystem
- Imagining Construction's Digital Future
- How Technology Is Revolutionizing Construction
- How Analytics Can Drive Smarter Engineering and Construction Decisions
- Artificial Intelligence: Construction Technology's Next Frontier
- Shaping the Future of Construction: A Breakthrough in Mindset and Technology
- Shaping the Future of Construction: Future Scenarios and Implications for the Industry
- Construction Analytics
- 2020 Engineering and Construction Industry Outlook
- Digital Disruption in Engineering and Construction
- How Technology Is Revolutionizing Construction
- The Transformative Power of Building Information Modeling
- The BIM Revolution Comes to Building Materials
- An Action Plan to Accelerate BIM Adoption
- How Big Data is Transforming the Construction Industry
- How the Construction Industry is Using Big Data
- How can big data analytics add value to BIM
- What's limiting BIM adoption in construction?
- Common Data Environment CDE
- Digging for the Big Data Gold in Today's Construction Projects
- Big Data = Big Questions for the Engineering and Construction Industry
- 2019 Construction Technology Report