Innovation Insight for Building Information Modeling

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Initiatives: Manufacturing Digital Transformation and Innovation

Building information modeling is a discipline supported by software to capture, organize and manage information needed to design, create, evolve and operate facilities. CIOs should use the implementation basics in this research to understand how BIM is evolving and begin BIM initiatives.

Overview

Key Findings

- Beyond its traditional roles in design and construction, building information modeling (BIM) is becoming an integral part of smart building and sustainability strategies. BIM streamlines facilities management and user services from concept and construction to remediation or demolition.

- Business leaders are beginning to discover the greater strategic value of BIM to support the entire life cycle of a facility, including new revenue-generating and cost-avoidance business and service opportunities.

- BIM models have some key crossovers with digital twins. For example, properly maintained BIM models using dynamic Internet of Things (IoT) data reflect the evolution and life cycles of their physical counterparts and can be used for planning and decision making affecting the actual facilities.

- BIM complements enterprise asset management (EAM) and integrated workplace management systems (IWMSs), where BIM supports facilities and structure design, and EAM and IWMS support the maintenance of the facility and consume BIM data.

Recommendations

CIOs seeking to transform and innovate facilities design and life cycle management by adopting BIM should:
Introduction

There are multiple views and definitions of BIM based on the implementation environment and the management and engagement role of the stakeholders working with it. In principle, BIM is the discipline of managing data and information about facilities, locations and physical infrastructure using an agreed-on, digitally enabled, shared-knowledge resource. This shared data and knowledge resource supports collaboration and decision making from earliest conception to demolition, and traceably captures the decisions and the outcome of those decisions throughout the life cycle. Figure 1 summarizes the core concept that a BIM platform supports content from all phases of a facility life cycle.

- Obtain leadership support for BIM by assessing its financial and business impact on managing and updating offices, factories, and other facilities and structures.
- Develop an agile data and software strategy by dashboarding BIM that can visualize the management of different facilities and building structures, as well as the performance and service environment.
- Establish a data-literacy and data-driven decision culture within operations and service delivery by creating IoT-derived data workshops that foster digital twin, machine learning and multidimensional data modeling for IT and engineering workflows.
- Mitigate BIM implementation failure risks by adopting standards and best practices, such as the British Standards Institution's (BSI’s) definitions of maturity levels 0 through 4, International Organization for Standardization (ISO) 16739, ISO 19650 and ISO 50000 on energy and environmental management or even Leadership in Energy and Environmental Design (LEED) certification.
Description

A BIM platform consists of a common data environment (CDE),\(^2\) which is an IT platform supporting a set of integrated or heterogeneous, orchestrated software applications that enable creating, sharing and managing digital content. Figure 2 summarizes the seven most recognized types (or dimensions) of content found on a BIM CDE.
Table 1 describes each of these types of content.
Table 1: Content Supported by BIM Platforms
(Enlarged table in Appendix)

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Source: Gartner (August 2021)

Ideally the content is organized into views serving roles such as engineers, construction planners, project managers, building superintendents and facility owners. Historically, BIM is associated with 3D CAD models and drawings. However, modern BIM enables combinations of data types (that may include or exclude CAD) that best serve the various roles. If any category of data updates, the role-based views update with change notifications.

Benefits and Uses

Benefits to the Business

The most broadly recognized business benefits that BIM will deliver across a building or structure life cycle include:
The ability of BIM to capture, control and share data across collaborative design, construction project development, construction project execution, facility maintenance and facility upgrades allows various roles to streamline workflows, work orders and asset locations; improve facility safety; and optimize facility utilization. Optimization includes improved circularity (see Quick Answer: How to Manage Climate Change Impacts as a Business Model in Manufacturing) and utilization as well as safety issues on the ground (see What Are the Core Functions of an Engineering Procurement and Construction Platform for Renewables (EPC-R)?)

Table 2 summarizes the benefits that IT organizations deliver to business stakeholders through BIM.
Table 2: CIOs Deliver Significant Business Value Through BIM

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These benefits are part of the network effect to application environments for consumer and industrial ecosystems. They justify the investment in BIM, with expected value increasing over time as BIM-related data will become more valuable, analytics more profound and technology more advanced (see Hype Cycle for Smart City Technologies and Solutions, 2021).

Extending the Value of BIM Through IT Modernization

Historically, BIM has focused on supporting facility design and construction. Increasingly, BIM planners think about leveraging BIM to deliver environmental, social and cost benefits throughout the life cycle of the facility.
BIM combined with IoT can be used to change operating parameters on an actual facility toward a smart building, factory or operations side. Therefore, through the BIM-IoT combination, the CIO provides facilities managers with a powerful new tool (see Innovation Insight for Digital Twins — Driving Better IoT-Fueled Decisions).

Adding sensors and analytics to BIM enables predictive management and maintenance to be more effective in the asset performance management (see Financially Optimized Maintenance Planning Using Asset Performance Management) and EAM systems deployed (see Market Guide for Enterprise Asset Management Software). These BIM extensions allow the ecosystem of the built environment, such as insurance, parking, mobility, utility, life science and communications providers, to potentially tap into building data that is necessary for digital business models.

The expanded scope allows the direct occupants, property owners, district managers, service providers, insurance and transaction brokers, and entertainment, health and safety organizations to understand direct-use, citizen and user engagement patterns. That will lead to data-driven decisions, ambience, health and safety, and better business revenue.

Some of the expanded use of BIM during a facility's service life extends to:

- Track and trace
- Predictive maintenance (for structural health and equipment such as elevators)
- Environmental monitoring and sustainability practices (air quality monitoring, litter control and water conservation)
- Energy management (lighting, climate control, renewable energy and electric vehicle charging)
- Smart building technologies (elevator sensing and scheduling)

BIM and smart building become critical for smart districts and campuses, whether they are universities, office parks, harbor districts or industrial parks (see Note 1). Smart city will extract the data and connect parking availability, microgrid and mobility, and establish end-to-end views of the building as part of the ecosystem of real estate, business revenue and sustainability in the ecosystem.
Benefits to CIOs

Most notably, BIM enhances the value of CIOs to the business through the positive impact of BIM throughout facilities' life cycles, as described above.

The value of having a common data environment for structured content, unstructured content, documents and models reduces the costs of maintaining interfaces across multiple applications. Although the costs of maintaining BIM increase over time as the amount of data and applications it includes increases, the overall IT costs will be lower than managing the content and applications in independent silos.  

In addition, CIOs benefit from using IoT and sensors generating operational data to manage facilities and operations, allowing for cost and time savings, and resulting in less capital expenditure. Real-time data connected to BIM, capitalizing on information technology/operational technology (IT/OT) convergences, optimizes efficiency and productivity. (See Merging IT/OT in a Digital Enterprise (Newcrest Mining Limited)). Although this example does not involve BIM, the IT/OT benefits described in this mining example are analogous to the IT/OT benefits of interfacing OT to BIM.

Risks

CIOs interested in adopting BIM face many challenges analogous to those they face when implementing product life cycle management (PLM) software or digital twins. The key risks include:

- Gaining user acceptance of BIM can prove difficult in architectural engineering and construction firms, which often focus on an engineering culture that is deeply ingrained (see Innovation Insight: Innovation Insight for Engineering Technology: Why ET, IT and OT Are More Than the Sum of Their Parts). Key users who can undermine BIM programs include business decision makers, such as COOs, facility managers and plant operators uncomfortable with BIM's impact on operations.

- Given the broad scope of BIM, there is a high risk that the implementations will be late with cost overruns through the lack of data governance or definition of data exchange. This will result in lower-than-expected ROI from BIM, as is the case with many categories of enterprise software.

- There is a high risk of scope creep and gaining consensus on BIM objectives.

- Reaching consensus about data architecture and model representations across BIM stakeholders in engineering, construction project planning, facilities management and contractor management will likely be challenging.
Adoption Rate

The global BIM market is projected to grow from $4.5 billion in 2020 to $8.8 billion by 2025, with a compound annual growth rate of 14.5%. BIM is ascending the Slope of Enlightenment as the investment grows (see Hype Cycle for Smart City Technologies and Solutions, 2021). Recent accelerated adoption is also being encouraged by regulations in many countries. A notable example is the U.K.’s mandate that requires that all publicly funded construction work must comply with BIM maturity Level 2, as defined by the BSI as one measure to help in fulfilling its target of reducing waste in construction by 20% (see Note 2).

Alternatives

- Digital twin technologies. They can be used to model and monitor structures and facilities (see Market Guide for Digital Twin Portfolios and Enabling Technologies).
- PLM software. It is typically used to design and manage products ranging from low-cost, high-volume commercial products to high-cost, low-volume products such as aircraft and ships. However, these tools are sometimes used in lieu of BIM for products that are typically constructed such as ships (see Proving the Value of a Digital PLM Ecosystem: B2B Discrete Manufacturing).

Recommendations

To successfully adopt and deploy BIM, CIOs must:

- Gain support from senior executives by working with business leaders in engineering and facility maintenance to build a compelling business case that offers evidence of money saved and better business performance.
- Provide for a solid IT foundation by deciding on communications and data infrastructure, cybersecurity issues, data architecture, and data privacy-related operations management.
- Reduce the risk of failed BIM implementations by phasing the implementations into smaller focused projects that build on each other.

- Address BIM data architecture challenges by assigning IT architects responsible for BIM implementation to work with key BIM stakeholders in engineering, construction management and facility maintenance.

- Enable productive BIM collaboration capabilities by assigning a BIM lead to run a project that defines corporate standards to work with BIM.

- Train senior executives to use BIM by running educational sessions for them on management functions such as project costs and status.

- Drive the link to a data-sharing environment by implementing a smart building approach, using system and performance data to develop a sustainable and ambient workplace.

- Design ICT and networking capabilities by including immersive technologies, data standards (see Note 3) and governance to support automated and trusted data exchanges.

**Representative Providers**

- Asite
- Autodesk
- Bentley Systems
- Dassault Systèmes
- Hexagon (Intergraph)
- Nemetschek Group
- RIB Software
- Schneider Electric (AVEVA)
- Siemens
- Trimble
Evidence

1. **OpenBIM**, buildingSMART. Various processes, including openBIM, can facilitate interoperability to benefit projects and assets throughout the life cycle.

2. **Common Data Environment CDE**, Designing Buildings Wiki. CDE is the single source of information used to collect, manage and disseminate documentation, the graphical model and non-graphical data for the whole project team (that is, all project information whether created in a BIM environment or in a conventional data format).

3. **Streamlining the Modeling Process by Exporting Data Within BIM**, Engineered Systems. Through its data models, BIM allows the ability to digitally orchestrate a variety of different data sources in a program without relying on individually manually transferred data sources, which could be filled with errors or inaccuracy.

4. **BIM: Cost vs Benefits**, Building. Describes the cost and benefits of the implementation of a BIM solution. While aligned for the U.K., it still demystifies some of the key issues and the impact on asset and building quality.

5. **Building Information Modeling Market**, Research and Markets. The report defines, describes and forecasts the BIM market based on type, project life cycle, applications, end users and geography. It provides detailed information regarding factors such as drivers, restraints, opportunities and challenges influencing the growth of the market.

6. **BIM Adoption in China: 3 Projects Implemented With BIM**, BibLus. Describes the three newest projects in China, where designers and companies have integrated a high level of BIM adoption since 2016 in a context of rapid building growth and industry modernization.

7. **Here Are Some Projects Constructed Using BIM in India**, TechnoStruct. Four projects have drawn high-profile interest in India, including the Bangalore Airport.

8. **Building Construction and BIM in Japan**, Japan Federation of Construction Contractors. Describes the benefits achieved in Japan, including acceleration of the process of reaching a consensus with a client and a designer; improvement of the coordination process between subcontractors, fabricators and manufacturers; and improvement of the productivity and shortening construction period by front-loading.
9 Germany and Russia Close in on UK’s European BIM Leader Status, Planning, BIM & Construction Today. Germany’s government is investing in BIM standardization, skills training and support for BIM projects, while Russia is on a steep upward trajectory since its first BIM projects in 2014.

10 BIM Progress & Adoption in the UK, UK Construction Online. As a steadily increasing number of firms move to Level 2 BIM adoption in the U.K., the government is planning on advancing to Level 3 BIM adoption, which is expected to provide construction with a productivity boost, increased data handling, a greater role for smaller markets and higher quality.

11 Status of BIM Adoption in the US, BIMForum-buildingSMART. The use of BIM is widespread in the U.S. after increasing 64% in a five-year period. Most disciplines use BIM, which is applicable to most projects.

**Note 1: BIM, EAM and IWMS Concepts Extend to Smart Cities**

Over the past 10 to 15 years, as the concepts of smart buildings and smart cities have evolved, a well-conceived BIM architecture can extend to the sensors, electronics and software that are used to monitor and maintain the facility or structure (see Industry Data Governance Is Key to Developing a Smart City Platform).

**Note 2: The U.K.’s National Building Specification**

For more information about the National Building Specification, see NBS Overview, NBS Source.

**Note 3: BIM ISO Standard ISO 29481-1:2016**

To the extent possible, corporate standards should align with ISO standards. For example, ISO 16739, commonly known as industry foundation classes, is an open international standard for sharing BIM-related data (see ISO 16739-1:2018). Another ISO standard, published during 2018, addresses organization and digitization of information about buildings and civil engineering works, including BIM (see ISO-19650:2018).

**Document Revision History**

Technology Insight: BIM Addresses Digital Workplace and Asset Management Priorities - 5 March 2018
Recommended by the Authors

Some documents may not be available as part of your current Gartner subscription.

Use the Internet of Things in Smart Buildings to Achieve Work-Life Ambience
Cloud-Based Enterprise Asset Management Continues to Face Headwinds
Innovation Insight for Digital Twins — Driving Better IoT-Fueled Decisions
IoT Enriches PLM With 360 Degrees of Product Life Cycle Data
Market Guide for Digital Twin Portfolios and Enabling Technologies
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