













Core Concepts and Implementation of BIM in Consulting Engineering Practice – CESA PN101

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Agenda Overview

- Understanding BIM and Its Industry Context
- Scope and Objectives of BIM Implementation
- BIM Execution Plan (BEP) and Project Workflow
- BIM Tools, Technologies, and Data Exchange
- Value-Added BIM Services for Clients and Stakeholders
- Challenges and Barriers to BIM Implementation
- Allocation and Distribution of Liability in BIM Projects

Understanding BIM and Its Industry Context

Definition and Purpose of BIM

BIM Definition

Building Information Modelling (BIM) is a process that begins with creating an intelligent 3D design model and then uses that model to facilitate coordination, simulation, and visualization, as well as helping owners and service providers improve how buildings and infrastructure are planned, designed, built, and managed.

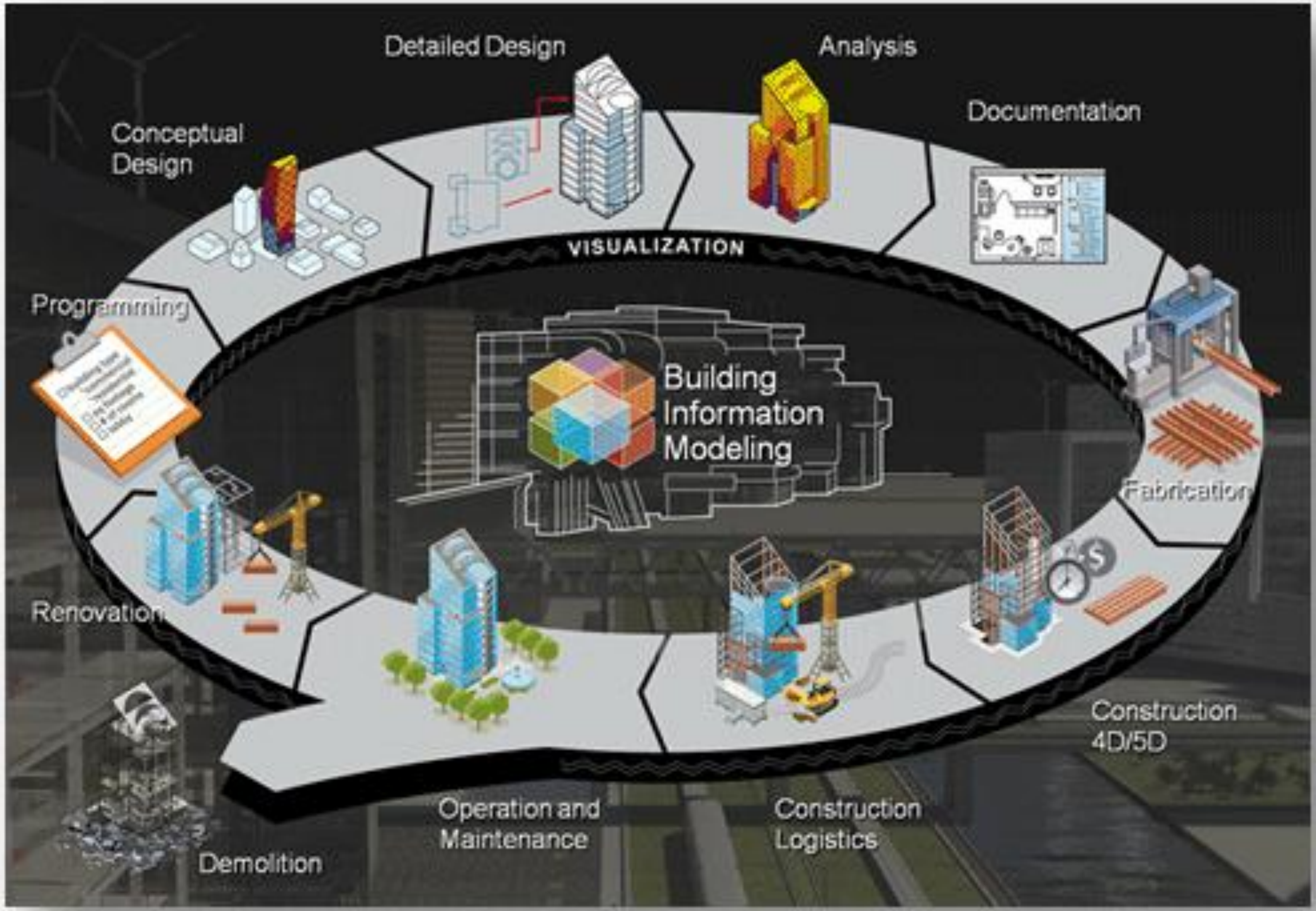
Purpose

BIM can alleviate many of the business challenges that architects, engineers, construction professionals, and owners face by providing greater project insight earlier in the design and construction process to help them make more informed decisions

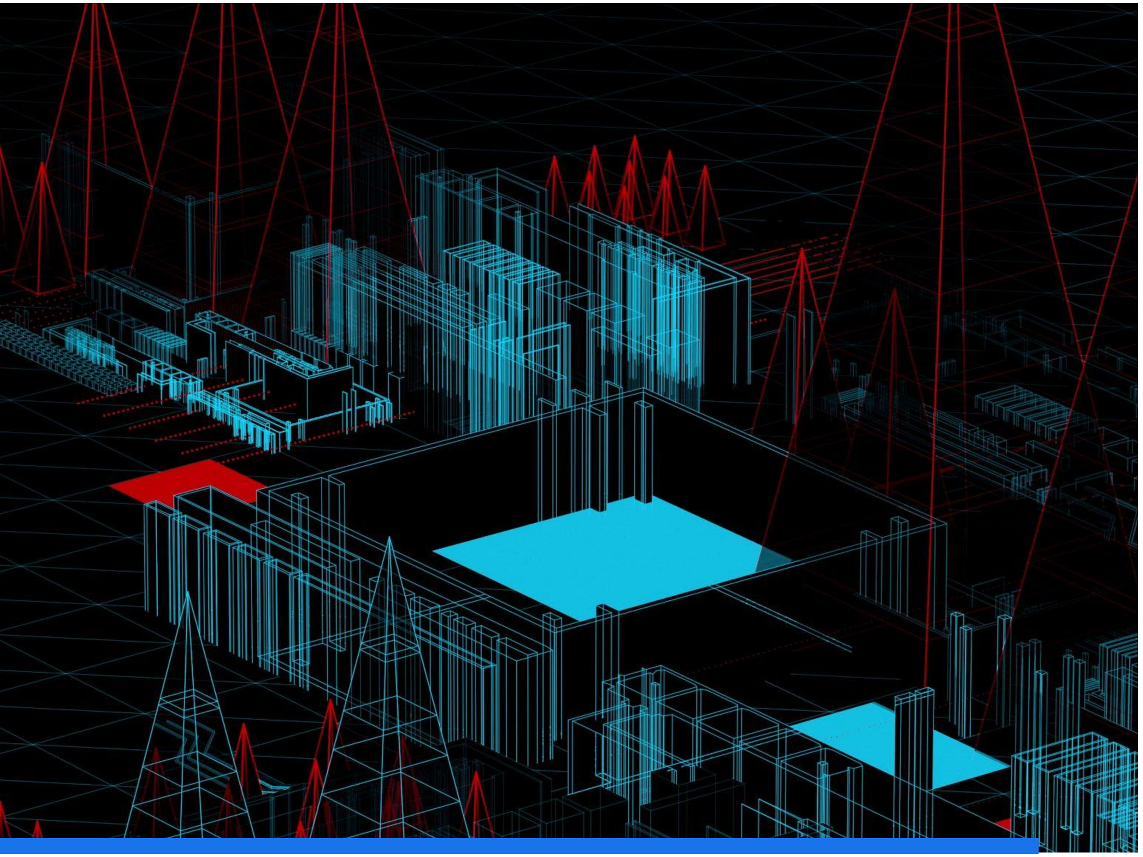
On a project that takes advantage of BIM, information is coordinated and consistent, creating efficiencies throughout the project lifecycle.

BIM also improves planning, cost forecasting, and project control – making it easier for teams to collaborate and communicate.

The BIM Workflow and Lifecycle



BIM Adoption, Maturity, and Industry Challenges



BIM Adoption and Challenges

BIM adoption in South Africa is growing but hampered by inconsistent maturity, lack of skills, and absence of standards across the industry and within the various project disciplines. South Africa faces uneven BIM adoption, skill gaps, lack of standards, and resistance to change in the industry, compounded further by regional and technical knowledge differences across the private and public sector

Comprehensive BIM Framework

An often-missing element is a detailed BIM framework that guides implementation including scope, roles, standards, execution plans, and liability allocation and is an important element of understanding BIM and your individual firm and services offering.

Clear Scope and Roles

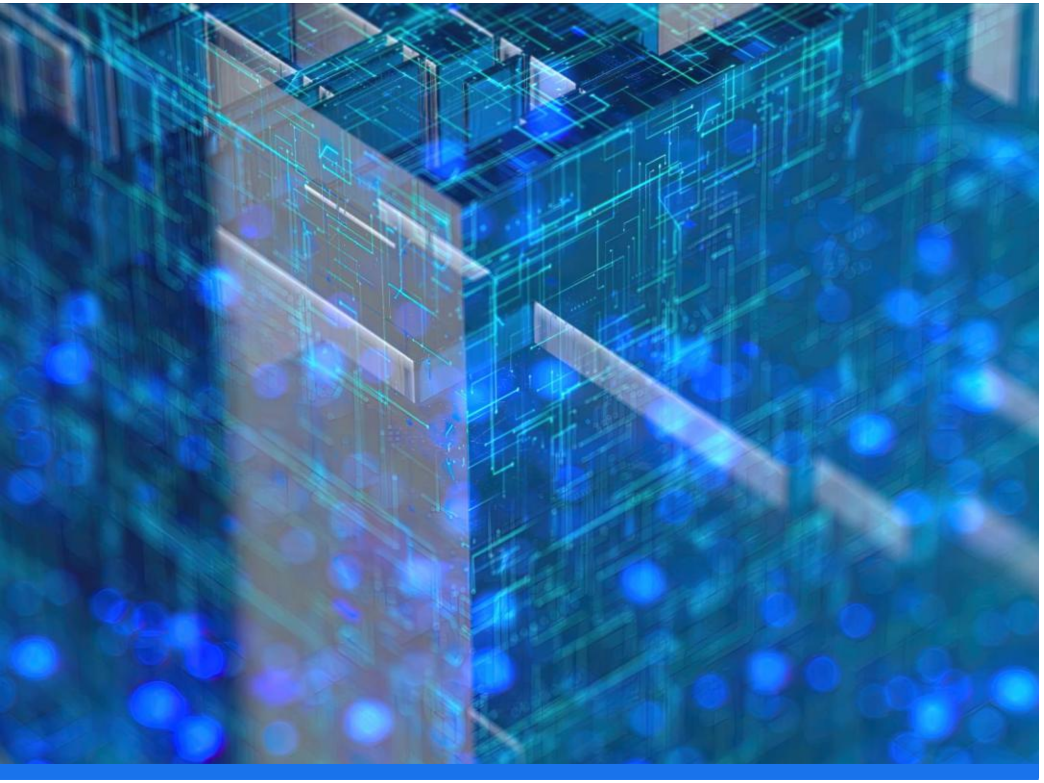
Defining project scope, objectives, software workflows, and roles like BIM manager and coordinator is essential for success and an integral part of the BIM Execution Plan..

Interoperability and Standards

Software incompatibility and data loss highlight the need for robust standards like ISO 19650 and improved protocols and diligent management with proactive risk mitigation..

Scope and Objectives of BIM Implementation

BIM is NOT an IT Project – Driving Change



Scope, Roles and Responsibilities

A BIM implementation must be supported by the business as a whole. It cannot be an IT initiative, or an R&D one, or done solely at a project or disciplinary level.

BIM Adoption Challenges

South Africa faces uneven BIM adoption, skill gaps, lack of standards, and resistance to change in the industry, compounded further by regional and technical knowledge across the private and public sector

BIM Vision

Driven BIM leadership

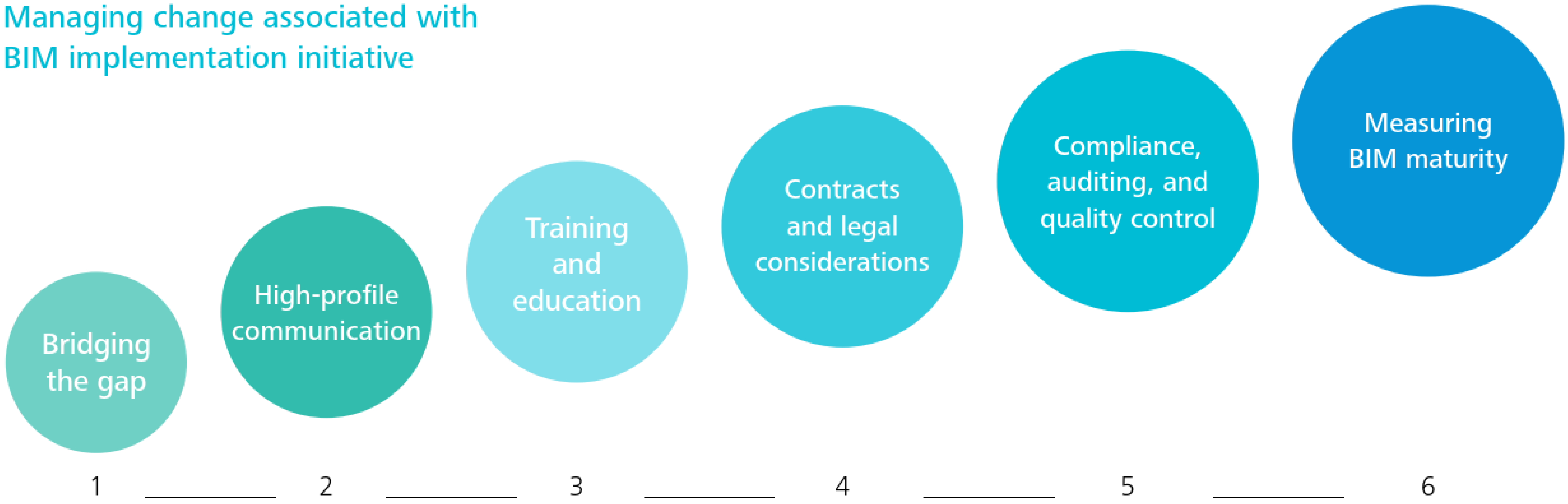
Gradual Integrated Change

Implementation

Changing Business as Usual

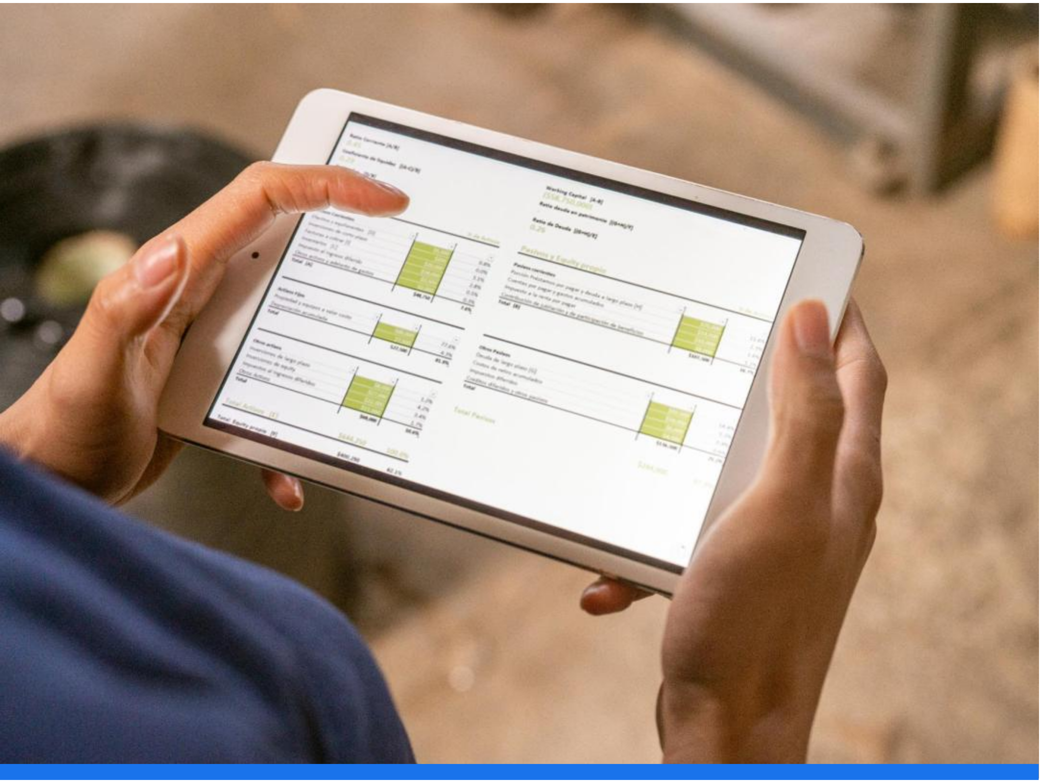
The BIM leadership team must ensure that the BIM vision is translated into actionable tactics to produce the desired outcomes and performance in line with an organization's strategic objectives.

Managing change associated with BIM implementation initiative



BIM Execution Plan (BEP) and Project Workflow

Purpose and Structure of the BEP



Comprehensive BIM Deliverables

BIM deliverables include drawings, reports, specifications, schedules, and models defined by geometric, alphanumerical, and documentation components.

Defined Roles and Responsibilities

Clear roles such as BIM manager, coordinator, modeler, and user are defined and communicated referencing ISO 19650 standards and a wealth of international supporting documents

BIM Execution Plan

The BEP outlines workflows, milestones, tasks, resources, and risks, developed collaboratively with project leadership and stakeholders.

Ongoing Scope and Objective Review

BIM scope and objectives are clearly documented, communicated, and regularly reviewed during the project lifecycle.

Components of the BEP

Project Information

Details such as the project name, location, a description, and a list of key stakeholders with their contact information.

BIM Objectives and Uses:

Clear definition of project-specific BIM goals and the intended uses of BIM throughout the project lifecycle (e.g., design coordination, clash detection, quantity take-off, facility management).

Roles and Responsibilities:

A clear outline of each team member's roles and responsibilities related to BIM implementation, such as a BIM Manager and BIM Coordinator.

BIM Process and Workflow:

A detailed description of the BIM process, protocols for collaboration, and the specific data exchange formats and software platforms to be used.

Information Management:

Standards for data, naming conventions, and requirements for the Common Data Environment (CDE).

Level of Development (LOD):

Specifications for the required LOD for models at different project stages.

Quality Control and Assurance:

Procedures for quality control, validation, and ensuring compliance with industry standards for all BIM deliverables.

Risk Management:

An identification of potential BIM-related risks and proposed mitigation strategies.

Delivery Strategy:

Project milestones, the schedule for deliverables, and plans for regular updates and reviews.

Collaboration and Communication:

Protocols and tools for collaboration, including clash detection processes and procedures for sharing and managing models and data.

Software and Hardware:

A list of the necessary BIM software and hardware, along with compatibility considerations.

Training and Support:

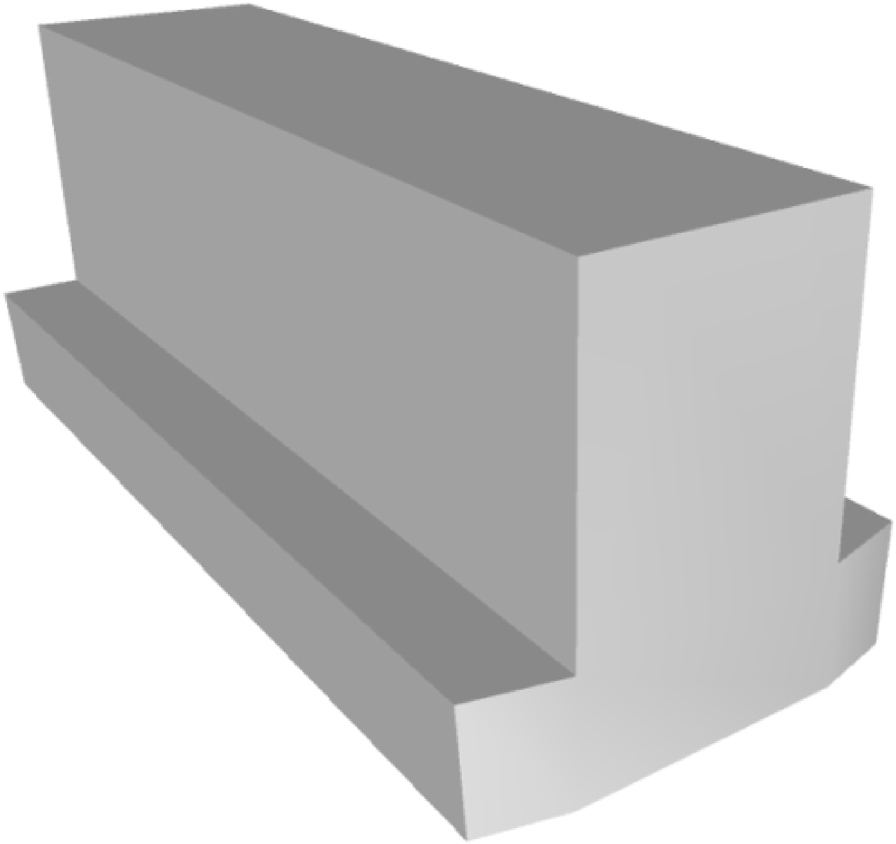
Details on the required BIM training and support for project team members.

Handover and Post-Construction:

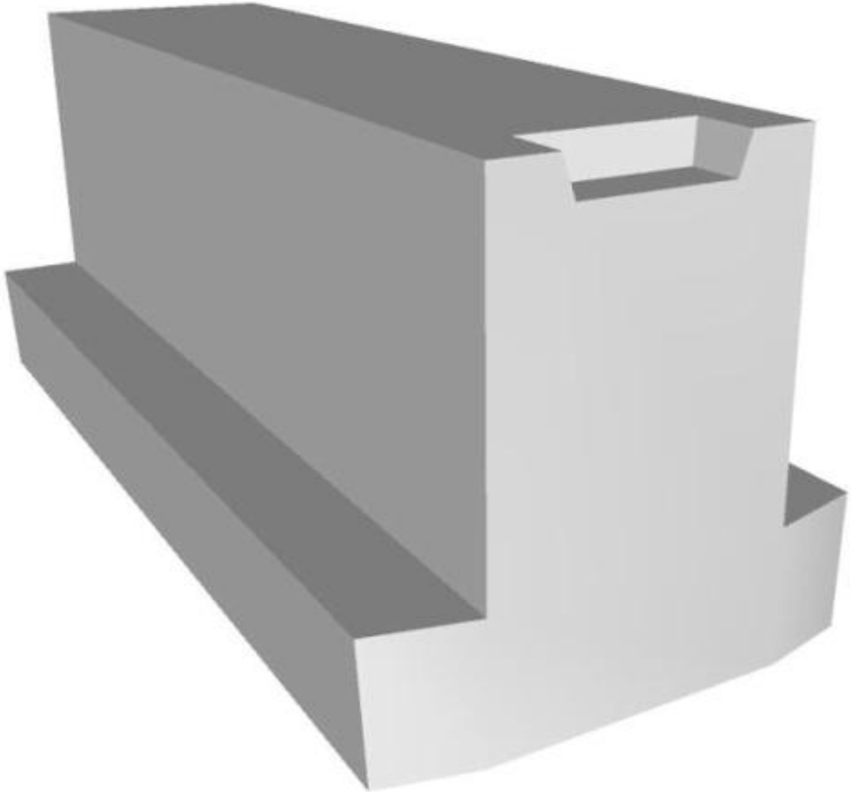
Guidelines for the handover of BIM data and models after project completion.

What is your LOD ???

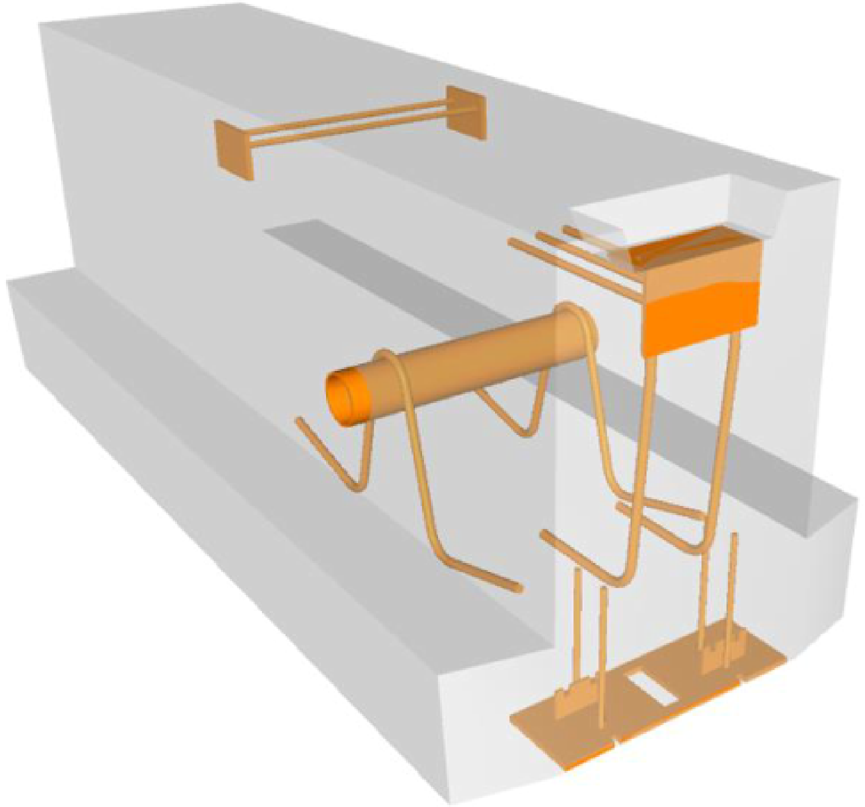
Level of Detail (LOD/LOIN), Dimensions, Uses, and Deliverables

200	Element modeling to include: • Type of structural concrete system • Approximate geometry (e.g. depth) of structural elements	 *14 B1010.10-LOD 200 Precast Structural Inverted T Beam (Concrete), From [lkerd.com]()*

Level of Detail (LOD/LOIN), Dimensions, Uses, and Deliverables

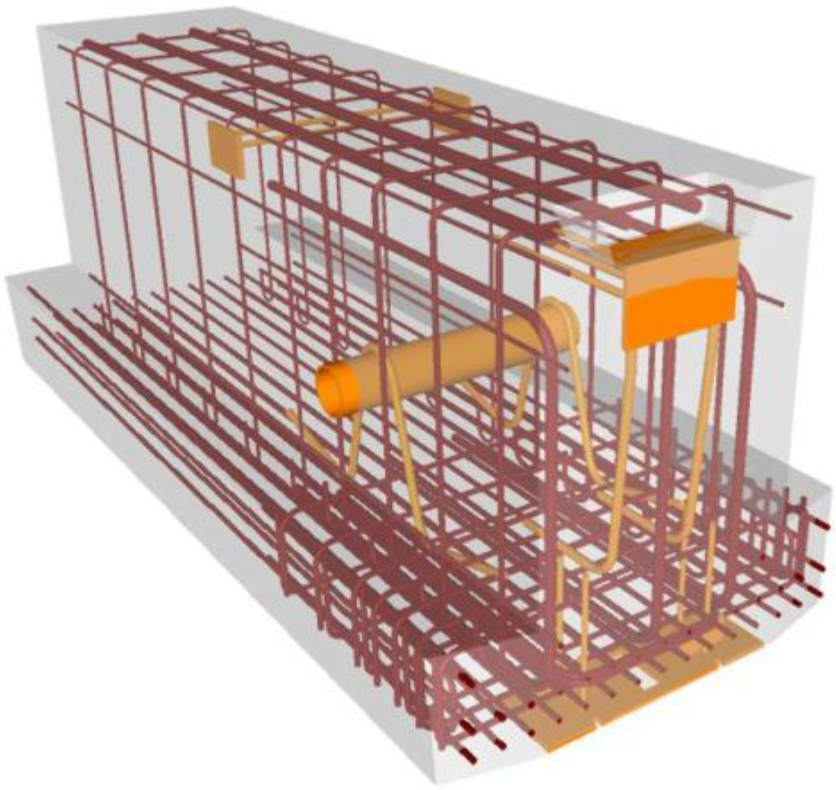
300	Element modeling to include: • Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation • All sloping surfaces included in model element with exception of elements affected by manufacturer selection	 *15 B1010.10-LOD 300 Precast Structural Inverted T Beam (Concrete), From [lkerd.com]*

Level of Detail (LOD/LOIN), Dimensions, Uses, and Deliverables

350	Element modeling to include: • Reinforcing Post-tension profiles and strand locations • Reinforcement called out, modeled if required by the BXP, typically only in congested areas • Chamfer • Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc. • Lifting devices • Expansion Joints • Embeds and anchor rods • Post-tension profile and strands modeled if required by the BXP • Penetrations for items such as MEP • Any permanent forming or shoring components	 *16 B1010.10-LOD 350 Precast Structural Inverted T Beam (Concrete), From Ikerd.com*

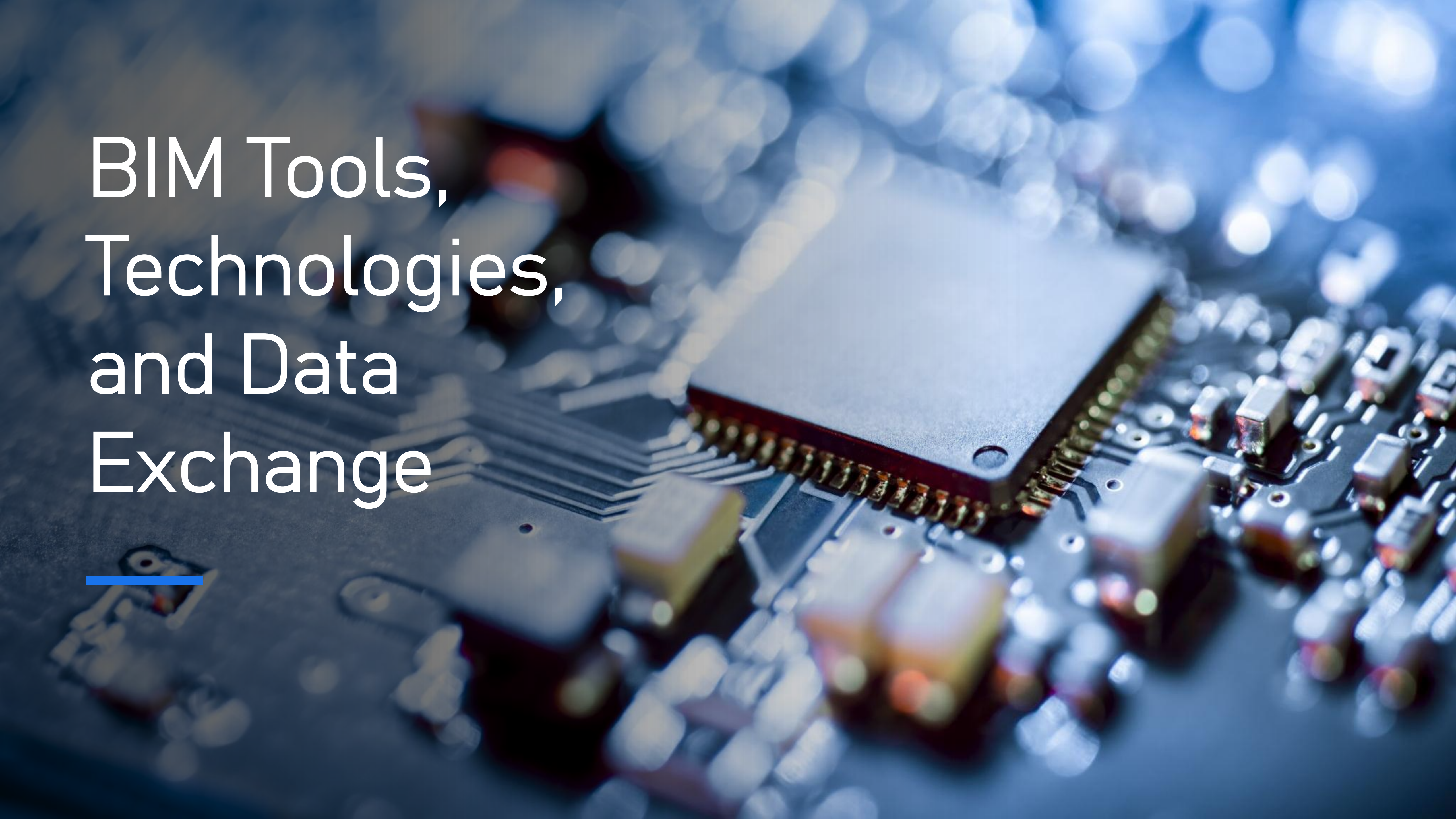
Level of Detail (LOD/LOIN), Dimensions, Uses, and Deliverables

400	Element modeling to include: • All reinforcement including post tension elements detailed and modeled • Finishes



17 B1010.10-LOD 400 Precast Structural Inverted T Beam (Concrete), From lkerd.com

BIM Tools, Technologies, and Data Exchange



Standards, Protocols, and Interoperability Challenges

Interoperability challenges

- Software incompatibility: Different software applications use proprietary file formats that are not inherently compatible, making data exchange difficult.
- Data loss: The conversion process between different software or file formats can lead to a loss of data, including crucial parametric information.
- Software version differences: Different versions of the same software can be incompatible, preventing smooth integration and model conversion between project members.

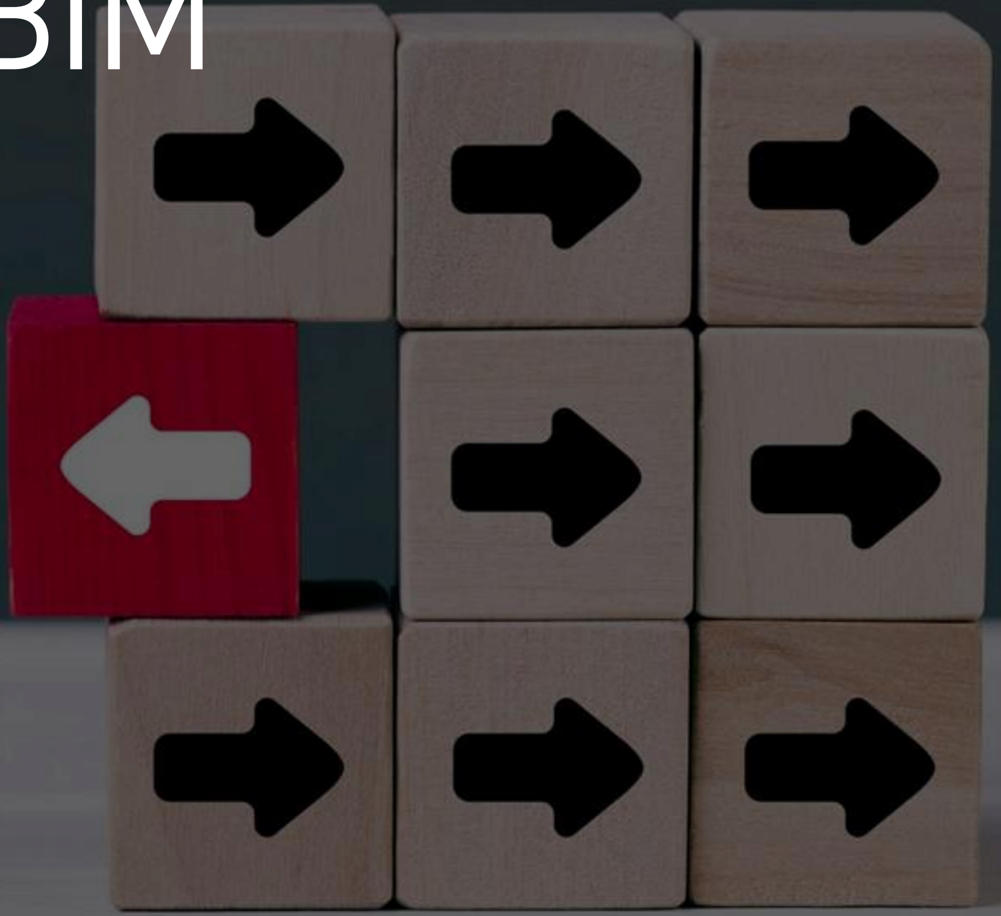
Standardization and protocol challenges

- Lack of industry-wide standards: There is a lack of universal standardization across the industry, leading to confusion and inefficient workflows when teams use different protocols.
- Non-standard data formats: The absence of standardized data formats across the industry makes data exchange complex and prone to errors.
- Lack of standardized processes: There is no universal set of standardized processes for data exchange and project workflows, which complicates efforts to ensure consistency.

Data and protocol challenges

- Data management and integration: Integrating and managing large volumes of data from various sources and systems can be overwhelming and complex.
- Parametric loss: Transferring models between applications can result in the loss of parametric information, which is a key benefit of BIM, making it difficult to make future edits.
- Inconsistent project protocols: Inconsistent standards and protocols are often applied across different projects and teams, which leads to confusion and inefficiencies.

Value-Added BIM Services for Clients and Stakeholders



Cost Estimation, Schedule Analysis, Clash Detection, and Facility Management

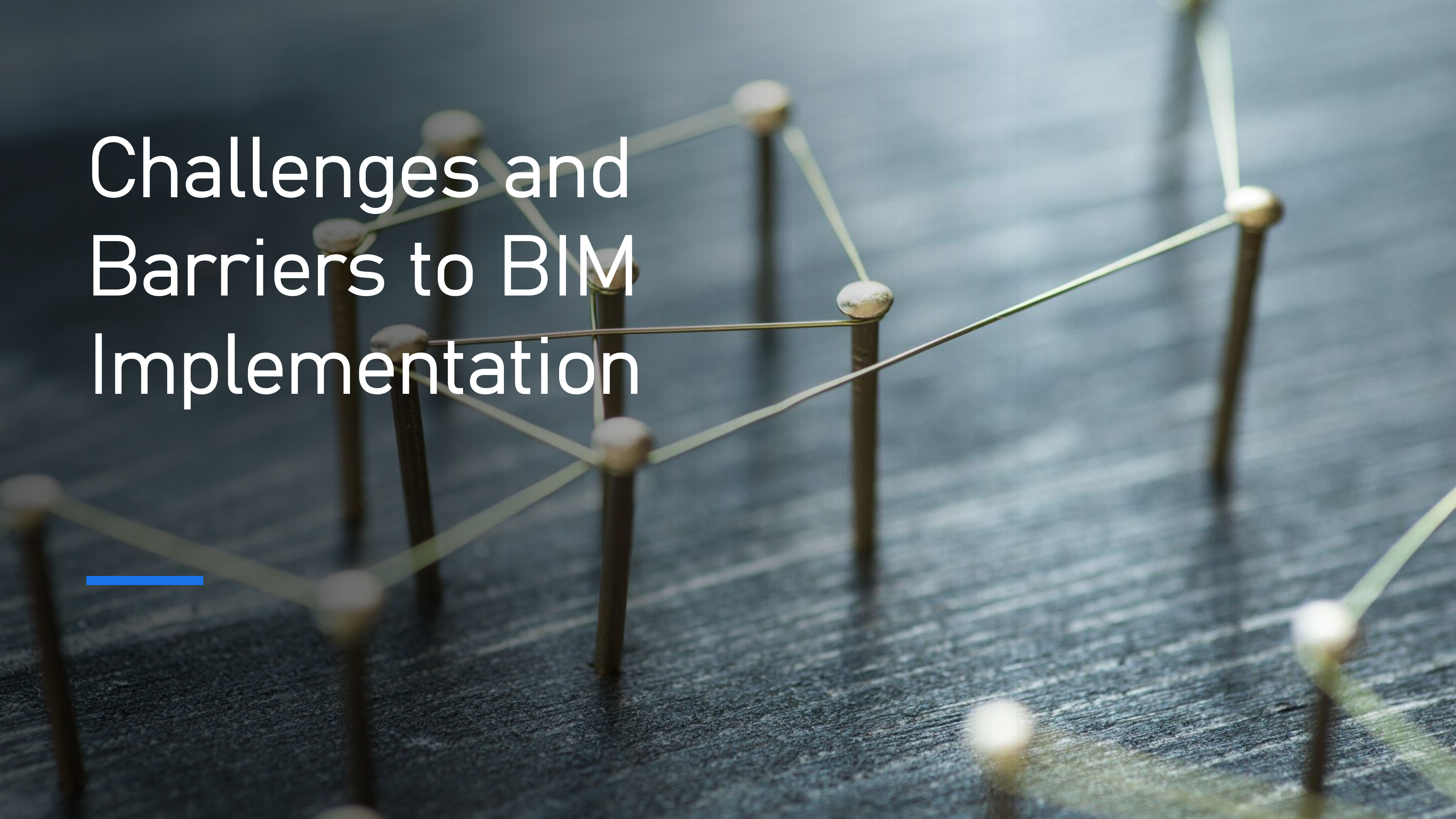
Cost Estimation: BIM enables accurate quantity take-offs directly from the model, improving cost forecasting and budgeting. Automated extraction of material quantities and component data reduces manual errors and speeds up cost analysis. Supports scenario analysis for different design options, helping clients make informed financial decisions.

Schedule Analysis: Integrates project scheduling (4D BIM) with the model to visualize construction sequences and timelines. Facilitates early identification of potential delays and bottlenecks, allowing proactive schedule management. Enhances coordination between design and construction teams, improving overall project delivery.

Clash Detection: Automated clash detection identifies conflicts between different building systems (e.g., structural, MEP) before construction begins. Reduces costly rework and change orders by resolving issues in the digital environment. Improves collaboration among stakeholders by providing a shared platform for issue tracking and resolution.

Facility Management: BIM models serve as a digital asset for ongoing facility management and maintenance (6D BIM).Provides detailed information on building components, systems, and maintenance schedules. Supports lifecycle management, enabling efficient operation, renovation, and future upgrades of the facility.

Challenges and Barriers to BIM Implementation



Skills, Education, Policy, and Change Management

Skills Gaps

The growing rate of BIM adoption and alignment with international practice has resulted in skills shortages in certain BIM skills, it is critical that the industry continue to build capacity to support ongoing advances..

Roles and Standards

Clear roles, responsibilities, and robust standards ensure successful BIM execution and contractual compliance and should be adopted, leveraging international experience to drive the best solutions in the local market

BIM Execution Plan (BEP)

Build strong policies around the BEP that aligns project deliverables with client requirements and serves as the contract backbone.

Challenges in BIM Adoption

Develop a change management strategy that fits the organization, organisational change is not easy but imperative. Leverage your software suppliers and the support of industry bodies and organisations.

Legal, Contractual, and Technical Risks

Legal and Contractual Responsibilities

Clear roles, liability distribution, and professional indemnity insurance are vital for managing BIM legal risks. Contractual agreements govern liability distribution among BIM contributors including architects and engineers and form the foundation of dispute resolution. Be sure to understand the risks.

Technical Risks and Infrastructure

Hardware and software play a critical role and cloud based computing continues to grow and as such connectivity is a critical risk in BIM data exchange but increase costs and introduce security vulnerabilities including cyber risk

Policy and Adoption Challenges

Skills gaps, evolving national standards, and resistance to change challenge successful BIM implementation and should be considered at each step of the BIM journey

National BIM Policy Development

South Africa's BIM national policy is under development, aiming to standardize BIM adoption and practices. Have your say and stay informed

Introduction – Legal Risks in BIM & CDE

Legal Risks in BIM & CDE

BIM and CDE enhance collaboration but introduce legal challenges around data ownership and access rights.

Common Disputes

Disputes typically involve design errors, intellectual property, and unclear contractual terms in project delivery.

Mitigating Legal Challenges

Proactive risk management and standardized protocols help reduce legal conflicts and ensure smooth project execution.

Common Causes of Disputes

Ambiguous Ownership

Unclear ownership of BIM models causes conflicts over usage rights and control between parties.

Access Rights Issues

Disputes arise when access rights to the Common Data Environment are contested or restricted.

Design Errors and Liability

Errors in BIM designs can cause project delays and cost overruns leading to liability claims.

Intellectual Property Concerns

Unauthorized reuse or modification of models raises intellectual property disputes among stakeholders.

Communication and Documentation

Poor communication and inconsistent documentation worsen misunderstandings and legal risks.

Case Study – Trant Engineering Ltd v Mott MacDonald Ltd (UK, 2017)

Dispute Over Data Access

The core conflict involved blocked access to BIM data after a business relationship breakdown.

Legal Decision Emphasizing Contracts

The court ruled for clear contractual terms governing data access and intellectual property rights.

Importance for BIM Projects

This case highlights the need for explicit agreements on data control and usage in BIM workflows.

Case Study – MEP Coordination Failure (US, Anonymous Parties)

MEP Coordination Discrepancy

The BIM model showed correct layouts, but conflicting 2D documents caused incorrect MEP installations.

Communication Breakdown

Failure in communication among designer, client, and contractor led to critical coordination errors.

Importance of Review Processes

Robust review and clear communication protocols are essential to prevent costly construction mistakes and legal disputes.

Design Errors and Delay Claims

Impact of Design Errors

Errors in BIM models can delay projects and increase costs, causing significant disruption to timelines and budgets.

Legal Claims and Disputes

Delays from design issues often lead to legal claims focusing on responsibility and project coordination failures.

Digital Accountability Shift

BIM use shifts liability focus to digital accountability, emphasizing the importance of review and validation protocols.

Mitigating Litigation Risks

Clear workflows, validation methods, and defined contractual responsibilities help reduce design-related legal claims.

Data Ownership and Intellectual Property

Defining Data Ownership

Contracts must clearly establish who owns BIM models and define access and modification rights to avoid disputes.

Legal Case Implications

The Trant v Mott MacDonald case highlights issues around unpaid invoices causing denial of data access and licensing conflicts.

Best Practices for IP

Grant royalty-free licenses upon payment, specify usage limits, and align with ISO 19650 standards to minimize legal risks.

BIM in Construction Defect Litigation

Digital Evidence in Litigation

BIM provides detailed digital records that aid courts in verifying construction compliance with approved plans and specifications.

Early Issue Detection

BIM enables early detection of construction issues through clash detection and simulation, preventing disputes before they arise.

Collaborative Transparency

Collaborative BIM use fosters transparency and reduces misunderstandings among project stakeholders, facilitating dispute resolution.

Lessons Learned – Contractual Best Practices

Defining Roles and Responsibilities

Clear definition of roles, responsibilities, and data access protocols reduces legal disputes and ensures smooth project execution.

Incorporating Standards

Using standards like ISO 19650 promotes consistent information management throughout BIM and CDE processes.

Addressing Legal Aspects

Contracts must cover intellectual property rights, licensing, dispute resolution, and professional indemnity insurance aligned with BIM risks.

Regular Protocol Updates

Regular review and updates of BIM protocols ensure adaptation to evolving technologies and legal frameworks.

Risk Management, Insurance, and Professional Indemnity

10.5	Summary
	In summary, the distribution of liability in BIM handover is a complex matter that requires careful consideration of contractual obligations, adherence to industry standards, and appropriate risk management strategies, including professional indemnity insurance. By addressing these aspects, professional service providers can effectively allocate and manage their liability in BIM projects.

Conclusion

Understanding BIM Concepts

A clear grasp of BIM principles is essential for successful consulting engineering projects.

This provides a sound understanding of the commitments and contractual obligations required to deliver a successful project while managing risk.

Structured Execution Plans

The organized and detailed execution plans ensure smooth BIM implementation and project progress and provides a clear project wide lens on roles and responsibilities and is a pivotal risk management resource and delivery driver.

Appropriate Tools and Management

Utilizing the right BIM software and proactive management addresses challenges and liabilities effectively while optimizing future workflows and embedding best practice in the organisation. This includes managing the contract , liability and risk.

Resources

RICS.ORG

- International BIM Implementation Guide
- BIM for Cost Managers
- BIM for Project Managers

Singapore Building & Construction Authority
WWW1.BCA.GOV.SG

- BIM Handover Technical Guide
- CDE Data Standard

BIMCOMMUNITY.AFRICA

- Convention for a Digital eSouth Africa: CoDE-SA

BIMFORUM.ORG

- 2025 BIM Execution Plan Guide
- 2024 BIM LOD Specification Guide
- 2025 LOA for Reality Capture

UKBIMFRAMEWORK.ORG

- Information management according to BS EN ISO 19650

AUTODESK.COM

- BIM 101 PDF Guide and Resources