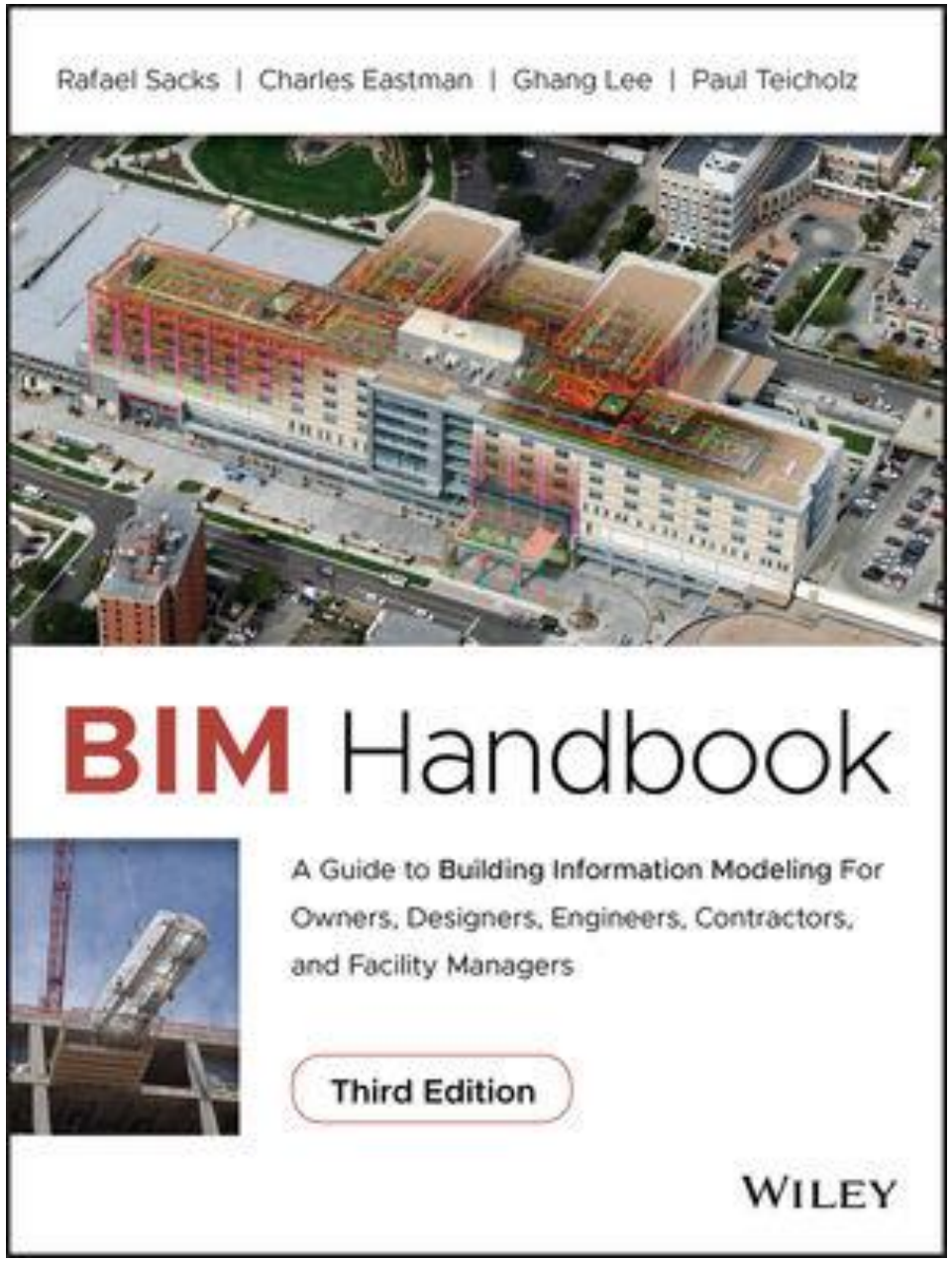
دانشگاه علم و صنعت ایران

مدل‌سازی اطلاعات ساختمان

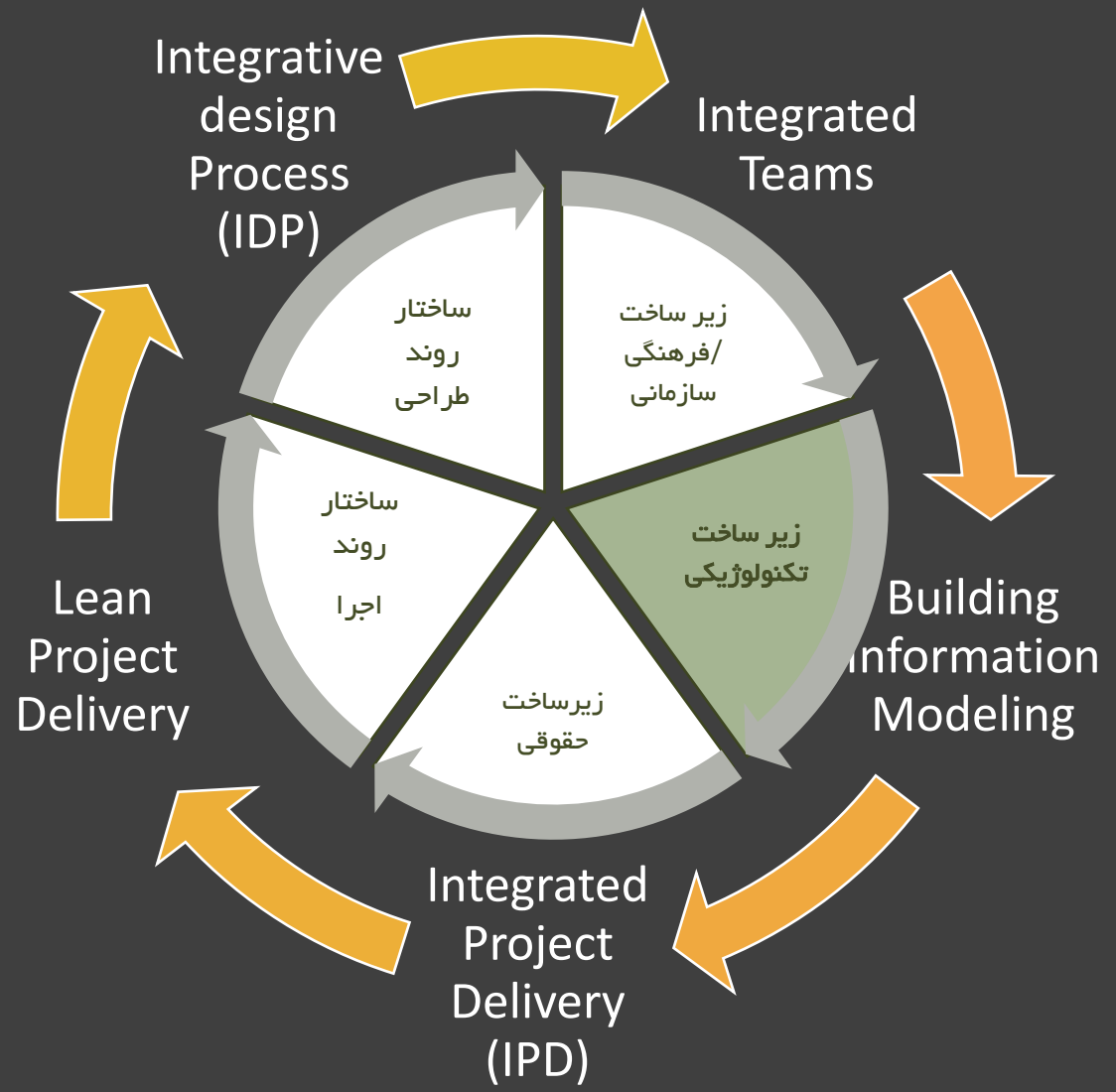
(Building Information Modeling)

جلسه چهاردهم– مبانی طراحی محیطی،
نظریه و روش‌ها– خرداد ماه ۱۳۹۹



Introduction

- **Inefficiencies of traditional documentation approaches**
- **BIM Introduction**
- **BIM Benefits**
- **BIM Challenges**



Inefficiencies of traditional 2D documentation

- Errors & omissions=>
  - Unanticipated field cost,
  - delays,
  - friction,
  - eventual lawsuits
- Considerable cost & expense required to generate critical assessment information:
  - Cost estimate
  - Energy use analysis
  - Structural details….

  => Performed at the end=> Too late

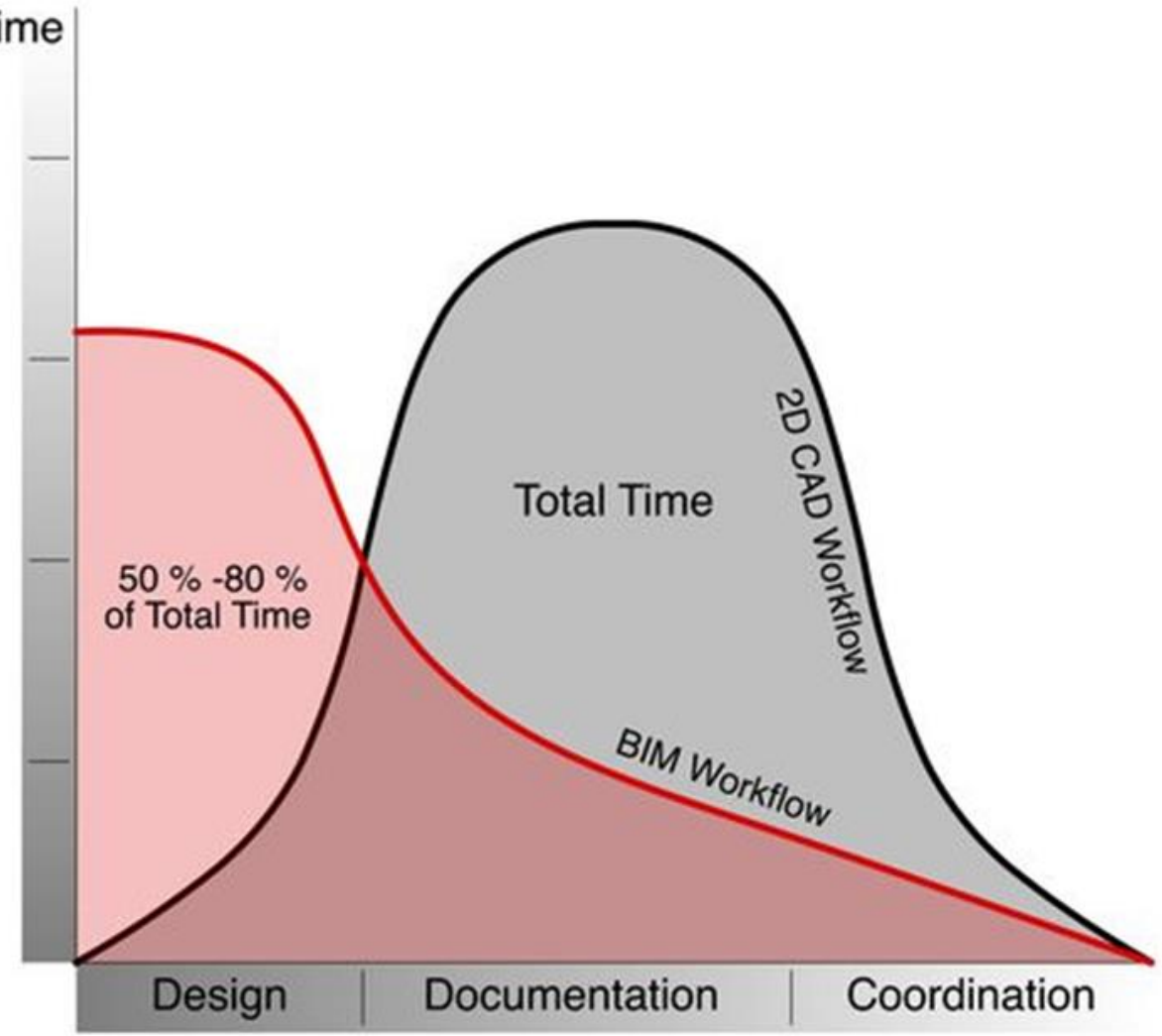
BIM Facts

The idea of BIM existed since 1970s

The software tools were developed in early 1980s

The term BIM was used in 1992 for the first time.

But gained popularity 10 years later.



What is BIM?

Building Information Modeling (**BIM**) is a process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of places.

Building Information Models (BIMs) refers to Building components that are presented with **digital representations** (objects) that carry computable **graphic** & **data** attributes that identify them to **software applications**, as well as **parametric rules.**

Parametric Objects

Consist **of geometric definitions** and **associated data and rules.**

Geometry is integrated **non-redundantly**, and allows for no inconsistencies.

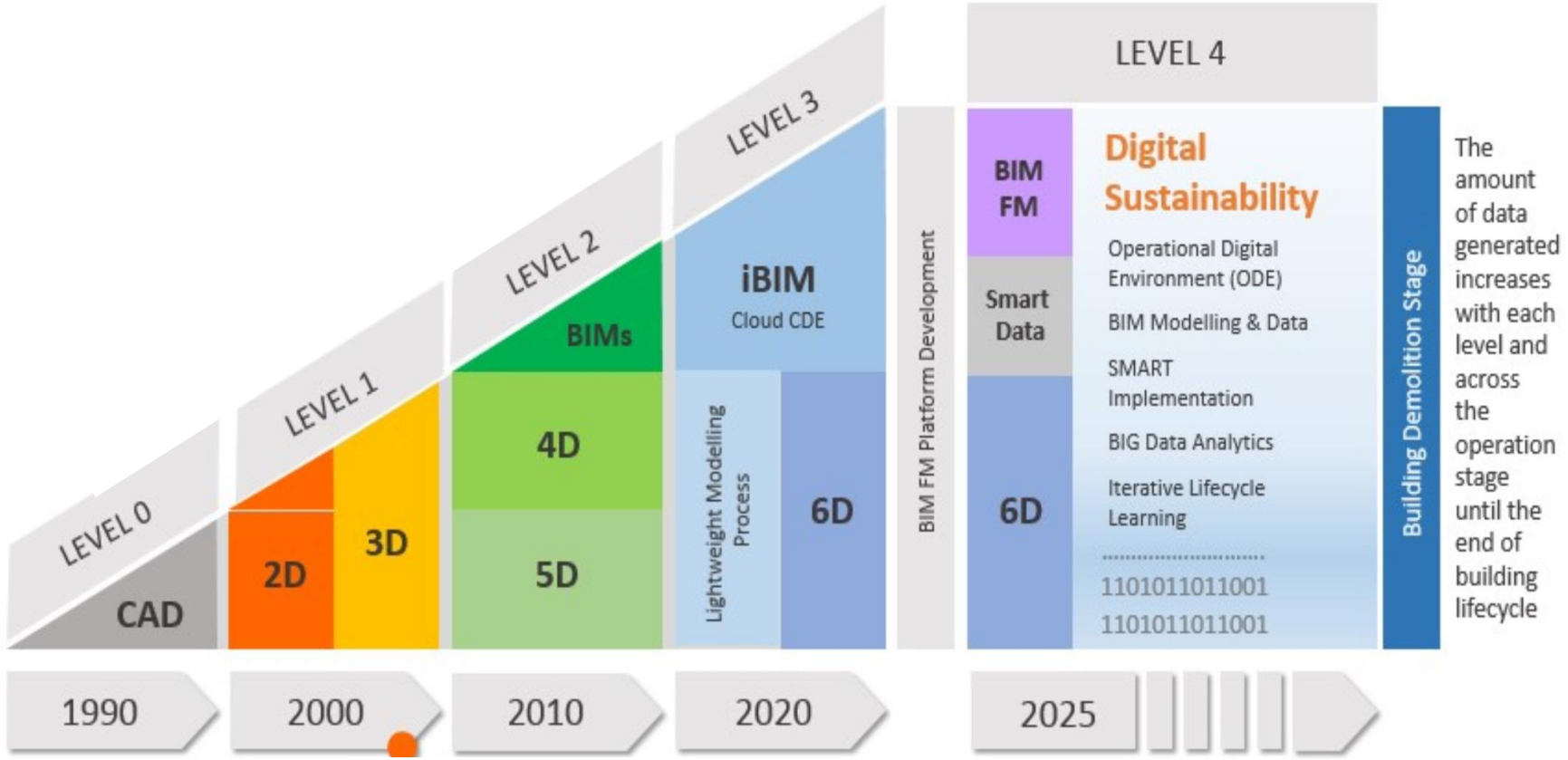
Parametric rules for objects **automatically modify associated geometries** when a new object is inserted into a building model or when changes are made to associated objects/ in all views.

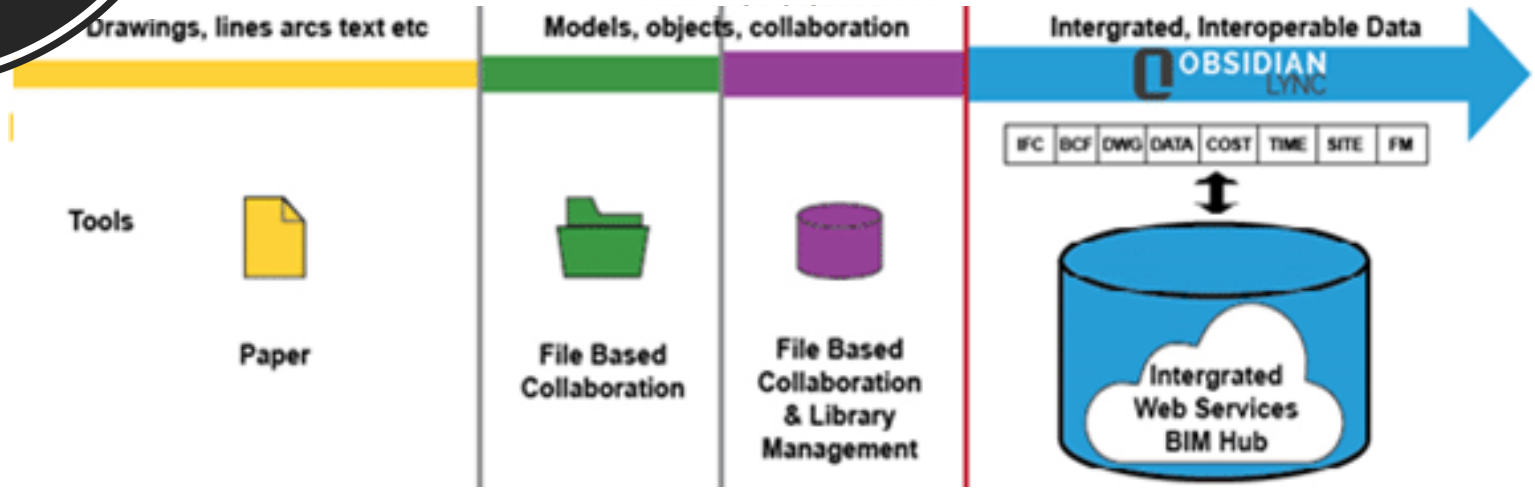
Objects can be defined at **different levels of aggregation**, so we can define a wall as well as its related components.

Objects' rules can identify when a particular change violates **object feasibility** regarding size, manufacturability, and so forth.

Objects have the ability to **link to or receive, broadcast, or export sets of attributes** to other applications and models.

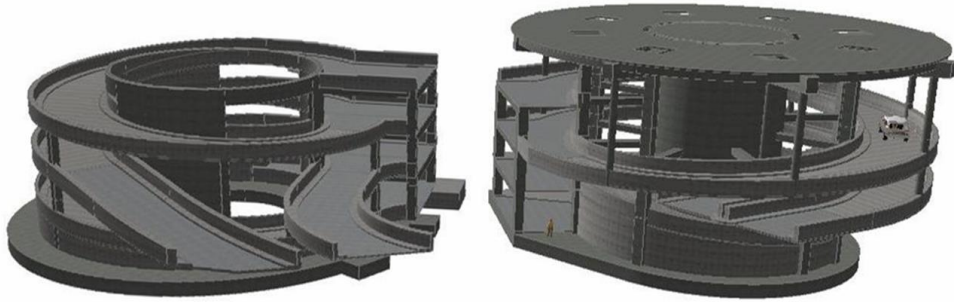
BIM Maturity Model



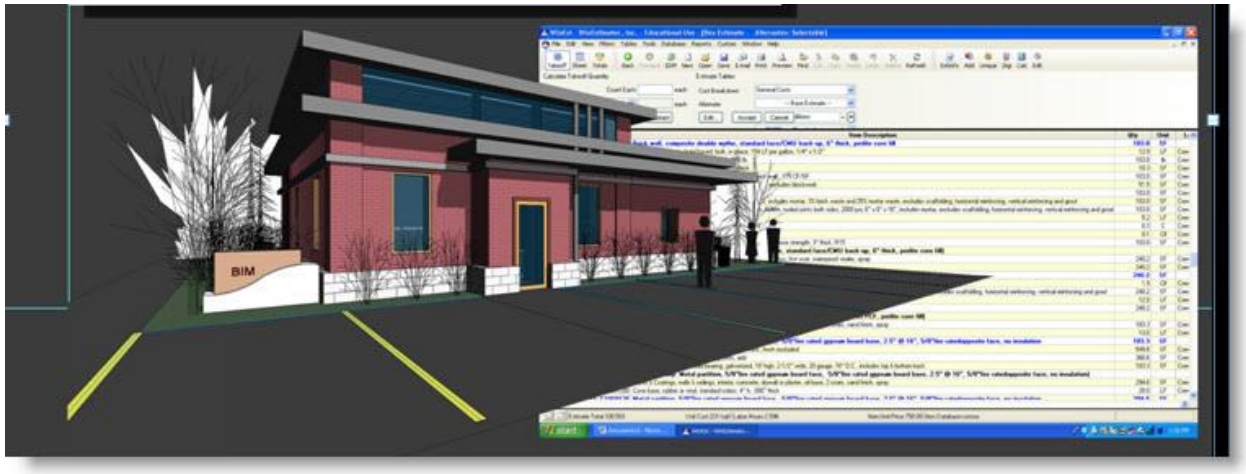


- Pre-Construction Benefits to Owners
- Benefits to Design
- Construction and Fabrication Benefits
- Post-Construction Benefits

Benefits of BIM



Pre-Construction Benefits to Owners

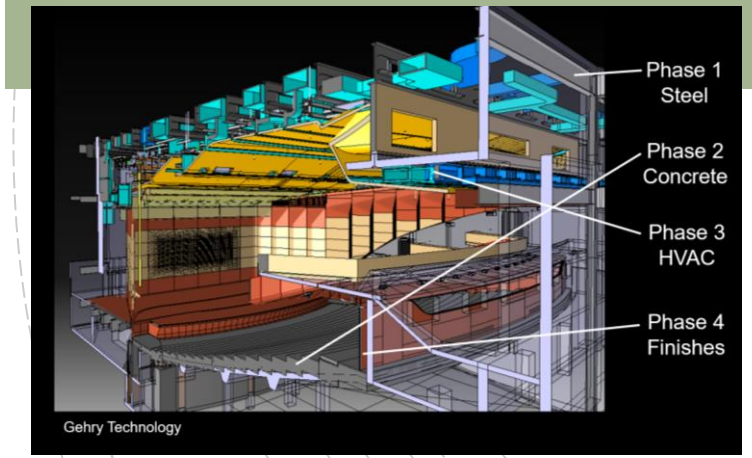


- Concepts (complex problems visualization, …), Feasibility (conceptual estimating & sequencing)=> Better Design Reviews
- System Selection Support (structural, Mechanical, Sustainability strategies) => Increased Building Performance & Quality
- Improved collaboration => facilitates IPD & IDP
- Jurisdictional Permitting

Benefits for Design

- Earlier & More accurate visualizations of design
- Automatic low-level corrections when changes are made to design
- Generation of Accurate and Consistent 2D Drawings at Any Stage of the Design
- Earlier Collaboration of Multiple Design Disciplines.
- Easy Verification of Consistency to the Design Intent.
- Extraction of Cost Estimates during the Design Stage.
- Improvement of Energy Efficiency and Sustainability.

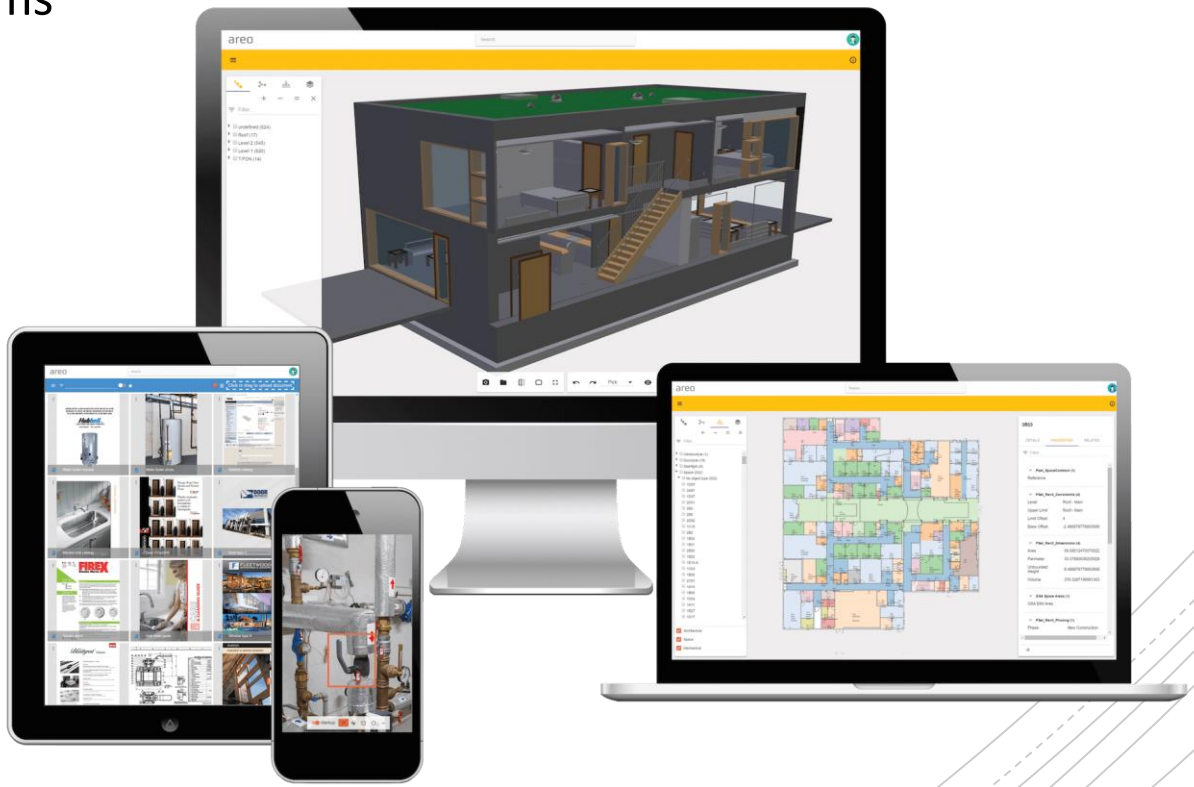
Construction & Fabrication Benefits



- Use of Design Model as Basis for Fabricated Components.
  - ⇒ Reduced construction cost & time
  - ⇒ Smaller crews
  - ⇒ faster installation time
  - ⇒ less on-site storage space.
  - ⇒ More safety
- Quick reaction to design changes
- Discovery of Design Errors and Omissions before Construction
- Synchronization of Design and Construction Planning
  - Clash Detection
  - 4D Modeling
- Better Implementation of Lean Construction Techniques.
- Synchronization of procurement with design & construction.

Post-Construction Benefits

- Improved Commissioning & handover of facility information
- Better management & operation of facilities
- Integration with Facility Operation and Management Systems



National Institute of Building Sciences
Facilities Information Council
National BIM Standard Committee

Architects & Engineers

Agency

Laws and regulations
-Building regulations
-Building specifications

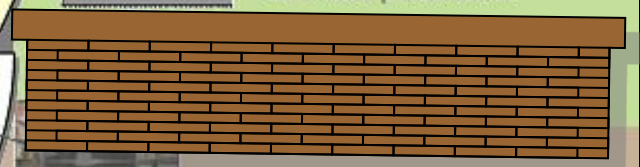
CAD software
-Drawings, calculations
-Architect, engineer,...

Knowledge databases
-Best practise knowledge
-Own practice

VRML
-Visualisation, 3D models

Briefing
-Functional req.
-Estimates
-Conditions
-Requirements

Simulations
-Comfort
-Ventilation, heating
-Life cycle cost
-Light, sound
-Insulation
-Fire, usage
-Environment
-Life time predictions



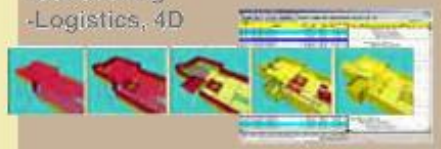
Demolition, refurbishment
-Rebuild
-Demolition
-Restoration

IFC + IFD product model

Specifications
-Specification sheets
-Classification standards
-Estimates, accounting

Facility management
-Letting, sale, operations
-Maintenance
-Guaranties

Construction management
-Scheduling
-Logistics, 4D



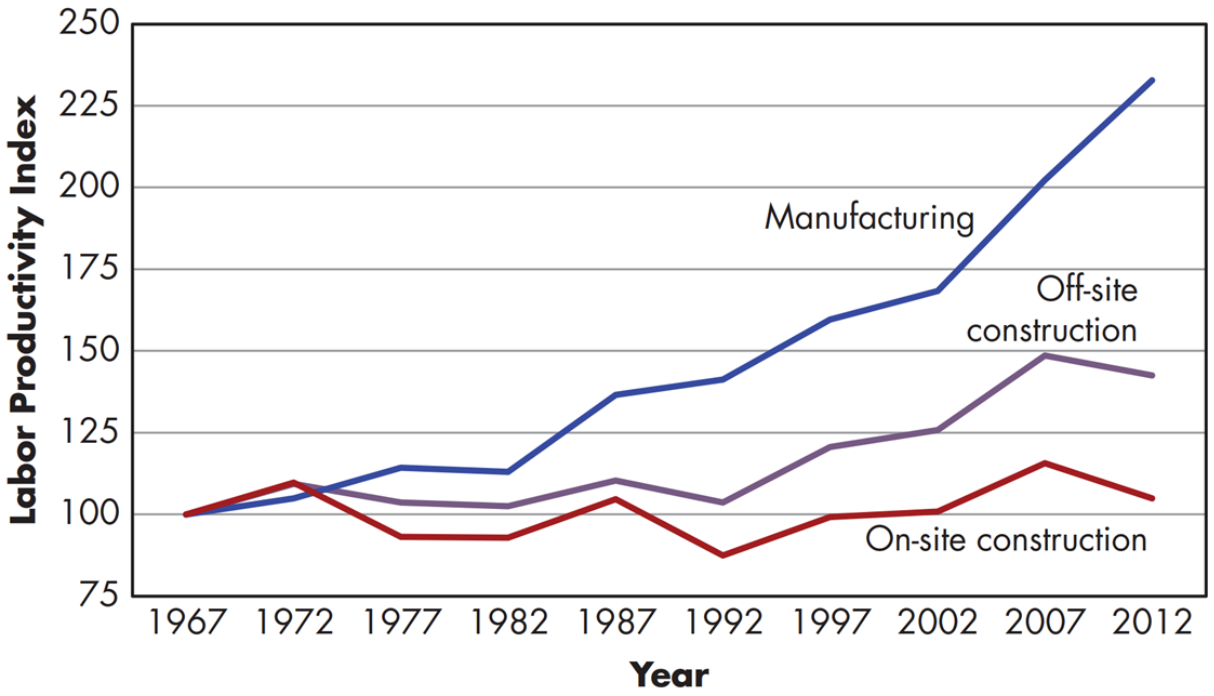
Procurement
-Product databases
-Price databases

Owner

Contractors

- External challenges (related to the nature of construction projects & Construction Market)
- Collaboration & teaming
- Legal challenges to documentation ownership & production
- Changes in practice & use of information
- Implementation issues

Challenges



External challenges (related to the nature of construction projects & Construction Market)

65% of construction firms consists of firms with fewer than 5 people

=> Hard to invest in new technologies

External challenges (related to the nature of construction projects & Construction Market)

- the use of immigrant workers has increased
- => discouraging the need for labor-saving innovations.

External challenges (related to the nature of construction projects & Construction Market)

45% of construction work relates to:

Addition	Alteration	Reconstruction	Repair

=> It is more difficult to use capital intensive methods for small scopes of work.

Reverting to paper/2D CAD drawings => All members can communicate => To keep the pool of potential contractors/subs bidding on a project large.

Local authorities still require paper submittals for construction paper reviews.

External challenges (related to the nature of construction projects & Construction Market)

Collaboration & Teaming

- Permitting adequate sharing of model information

=>Preparing a thorough BIM Execution Planning:

  - Specifying the level of detail needed for sharing information at each stage
  - Mechanism for model sharing (file based/model server)

- Interoperability issues
- Security issue

=>Information Security management/ Securing the servers

Legal Challenges to Documentation Ownership & Production

- Who owns the multiple design, analysis, fabrication & construction datasets?
- Who pays for them?
- Who is responsible for their accuracy?

=> Can be addressed in contracts

Changes in practice & use of information

- Integration of construction data earlier in the design process => More benefit to Design-Build & IPD contract arrangements.
- Intensive use of a shared building model during design, construction and fabrication.

Implementation Issues

- Acquiring software
- Training
- Upgrading hardware
- Fundamental Change in business processes

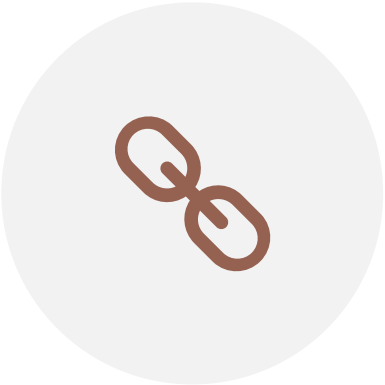
Implementation Issues

⇒Plan for implementation before conversion can begin:

- Assign top level management responsibility to developing BIM adoption plan.
- Create an internal team of key managers responsible for implementing the plan.
- Allocate time and resources for education in BIM tools and practices.
- Start using the BIM system on smaller projects in parallel with existing technology.
- Use initial results to educate and guide continued adoption of BIM software and additional staff training
- Extend the use of BIM to new projects/ use new collaborative approaches with outside members.
- Reflect these new business processes in contractual documents
- Re-plan the BIM implementation process to reflect the benefits and problems observed

Questions to Consider in writing the reflections

WHAT CHANGES IN DESIGN AND CONSTRUCTION PROCESS ARE NEEDED TO ENABLE PRODUCTIVE USE OF BIM TECHNOLOGY?



CENTRAL MODEL VS FEDERATED MODEL. IS A SINGLE CENTRAL MODEL PRACTICAL? DO FEDERATED SYSTEMS OF MODELS WORK BETTER FOR THE VARIETY OF DESIGN AND CONSTRUCTION TASKS?