IT in Construction

Lecture #6

Building Information Modeling

An introduction to Building Information Modeling (BIM)

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Construction Engineering and Management

Outline

- Diversity of construction industry
- Conventional computer aided tools
- BIM, new approach to address construction issues
- BIM capabilities
- BIM implementation examples
- BIM implementation challenges (BIM Pyramid)

Diversity of Construction Industry

Construction projects specification

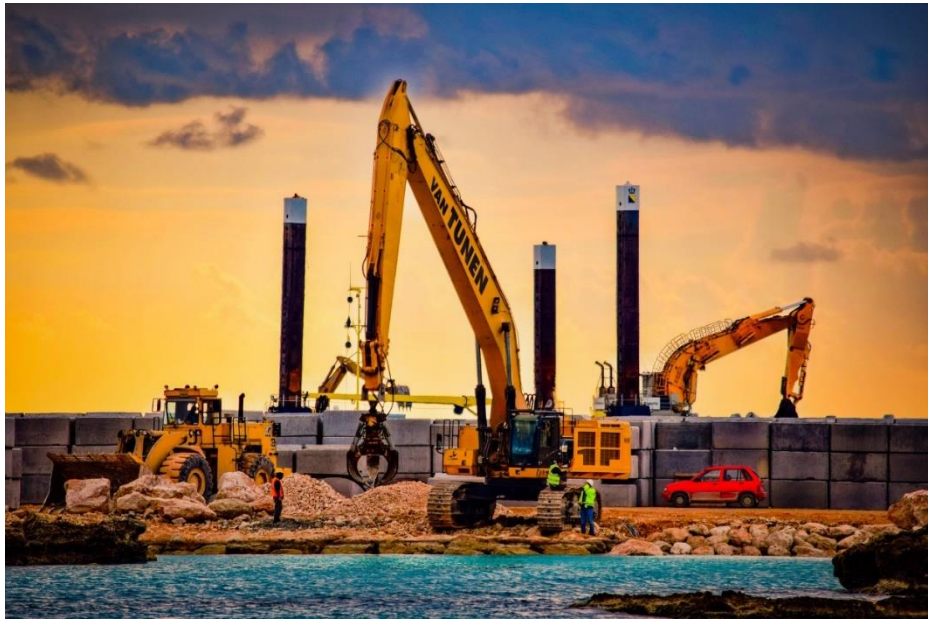
Construction projects should simultaneously address the **geography**, **site conditions**, **communities**, **physical environments**, **existing infrastructure**, as well as a wide range of **stakeholder requirements**. Adding to the complexity is the mix of **team specialists** and **contractors** (PMI, 2016).

Construction projects specification

Construction projects often result in a **one-of-a-kind product** rather than mass-produced products. While there is generally no opportunity to produce a prototype, a construction project may sometimes be performed in **phases** in order to provide an opportunity to review and refine the project design and implementation strategy, as well as validate the investment intention (PMI, 2016).

Construction projects specification

Construction projects are not always constructed in the performing organization's principal place of business, but may be constructed in **remote**, sometimes **hostile environments** on the open seas, beneath the surface of the earth, and towering high into the sky (PMI, 2016).



Construction projects specification

Inherently, construction projects occur in an **ever-changing**, **complex** environment, and often with a high degree of **risk**.

Buildings, highways, residential units, healthcare facilities, utility infrastructures, oil and gas, and other industrial facilities may appear typical, but each project presents its own challenges and risks (PMI, 2016).

Construction projects sectors

- Construction Sectors:
  - Residential construction
  - Commercial construction
  - Industrial construction
  - Infrastructure and heavy construction

Various skills in construction industry

- Construction industry is a combination of diverse fields of expertise and participants that have been *loosely* lumped together as a sector of the economy. **Name some of them!**










Various skills in construction industry

Construction projects often require the integration of engineering disciplines (**civil**, **structural**, **electrical**, **mechanical**, **geotechnical**, etc.) as well as interaction with **technology and sophisticated equipment** that demand unique construction techniques and methods (PMI, 2016).

Various skills in construction industry

- Major expertise involved:
  - Architecture (A)
  - Engineering (E)
  - Construction (C) (operation and management)

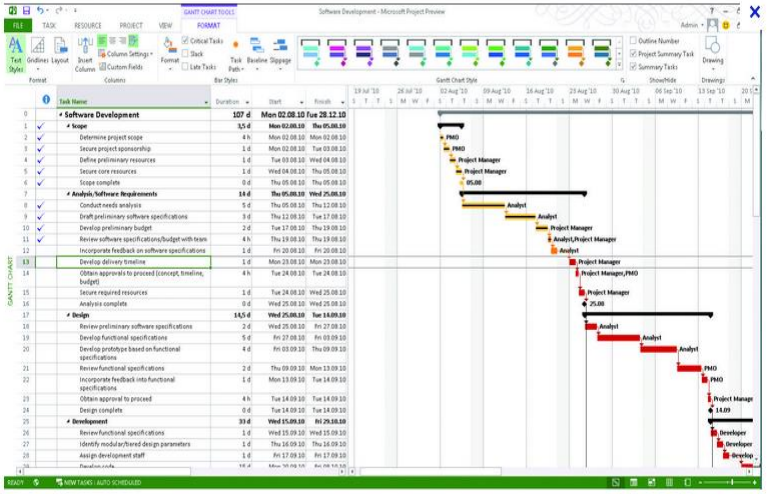
  This is reason the construction industry is also called ***AEC Industry***
- There are also affiliated expertise:
  - Professional services (legal, accounting, etc.)
  - Suppliers/ manufacturers
  - Financial Services
  - etc.

Conventional Computer Aided Tools

Pre-construction tools

- Planning Tools:
  - Scope, Schedule and Budget Planning Tools
    - **Microsoft Project**

- For enterprises of all sizes
- Project scheduling: define project tasks, assign them to the team, track in-progress assignments
- Project budgeting: estimate the costs for the entire span of a project.
- Perform “Earned Value Analytics”
- interactive dashboards and reporting functionalities
- Prepare insightful reports and make decisions about project execution and staffing levels
- Can be deployed both on-premise and in the cloud



Pre-construction tools

- Planning Tools:
  - Scope, Schedule and Budget Planning Tools
    - **Primavera P6**

❑Plan, schedule, and control large-scale programs and individual projects

❑Select the right strategic mix of projects

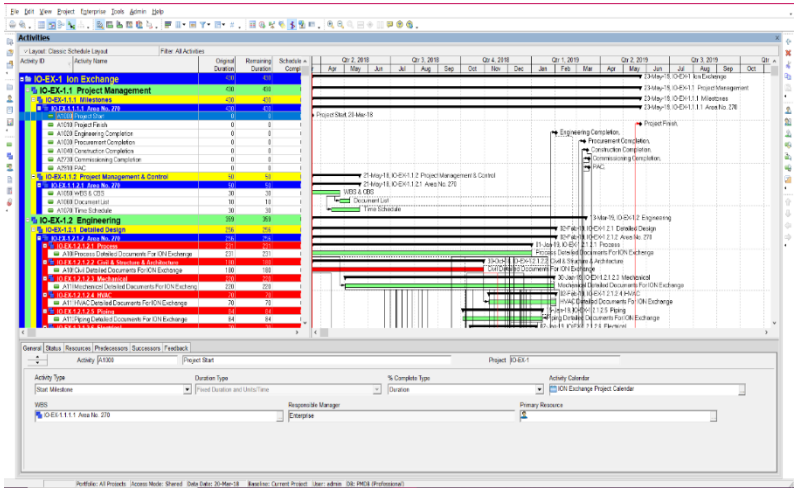
❑Balance resource capacity

❑Allocate best resources and track progress

❑Monitor and visualize project performance versus plan

❑Integrate with financial management and human capital management systems

❑Cloud-based solution



Pre-construction tools

- Design Tools:
  - Stakeholders Requirement Management
    - Pure expert judgment – general computer aided tools (e.g., MS Office)

Pre-construction tools

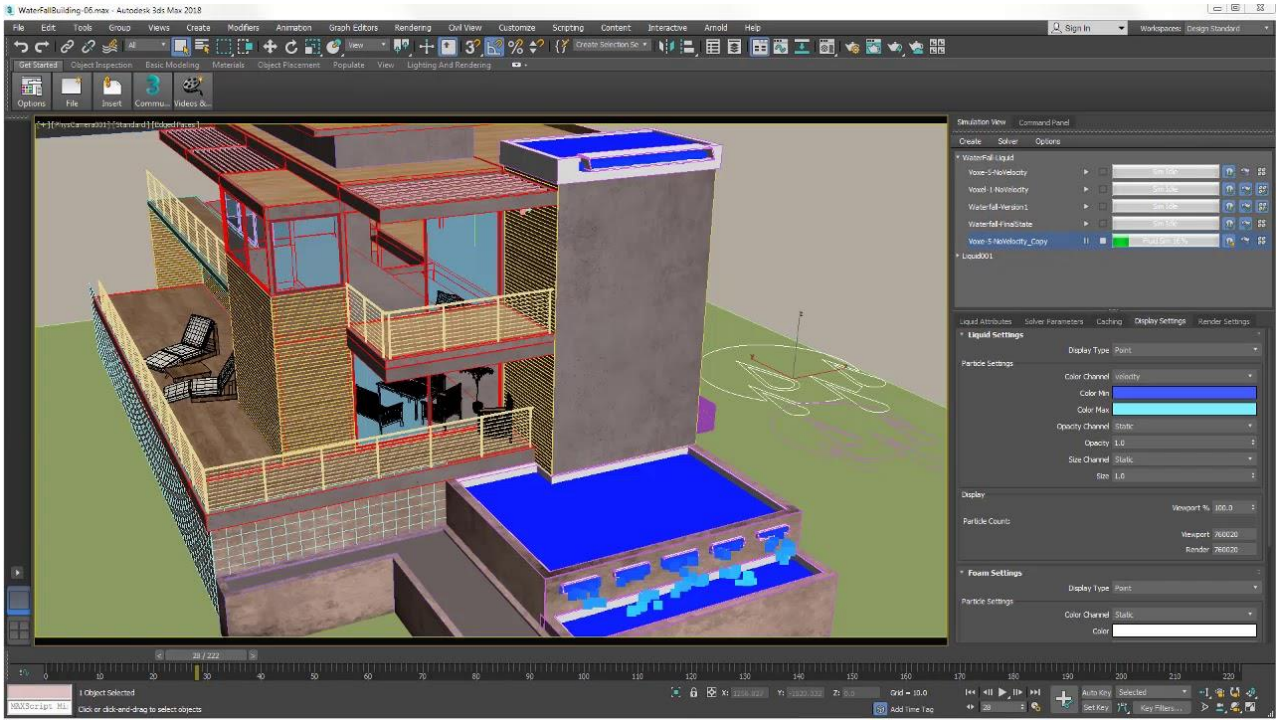
- Design Tools:
  - Architectural Design Tools
    - **Autodesk AutoCAD**

Pre-construction tools

- Design Tools:
  - Architectural Design Tools
    - **Autodesk 3Ds Max**

AUTODESK 3DS MAX

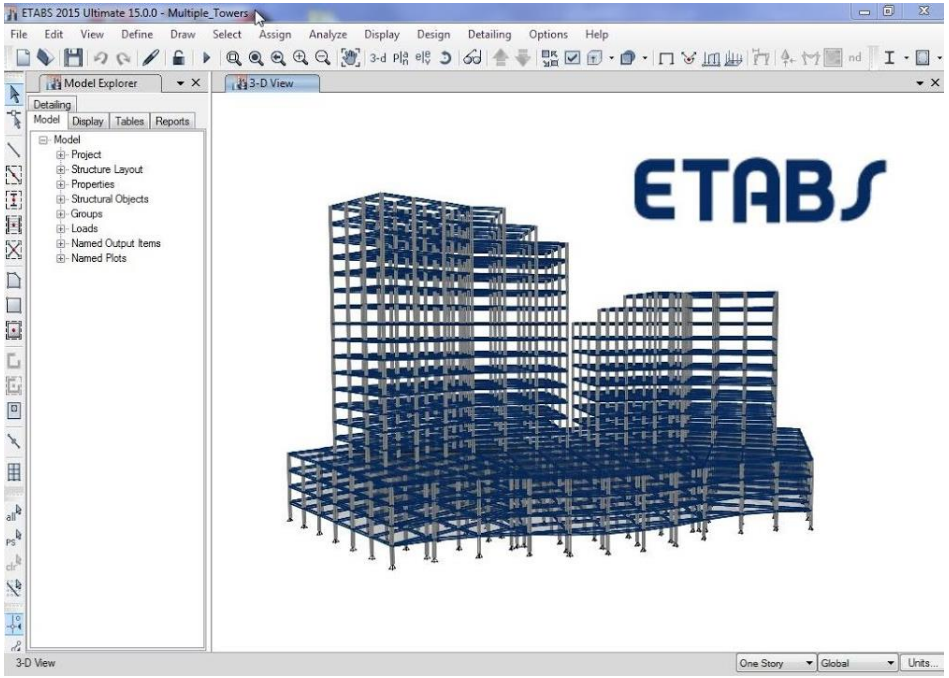
Formerly known as a 3D studio and 3D studio Max, 3ds Max is a 3D professional modeling, animation and rendering application build for making 3D animations, models, interactive games, visual effects for the entertainment industry.



Pre-construction tools

- Design Tools:
  - Structural Design Tools
    - ETABS

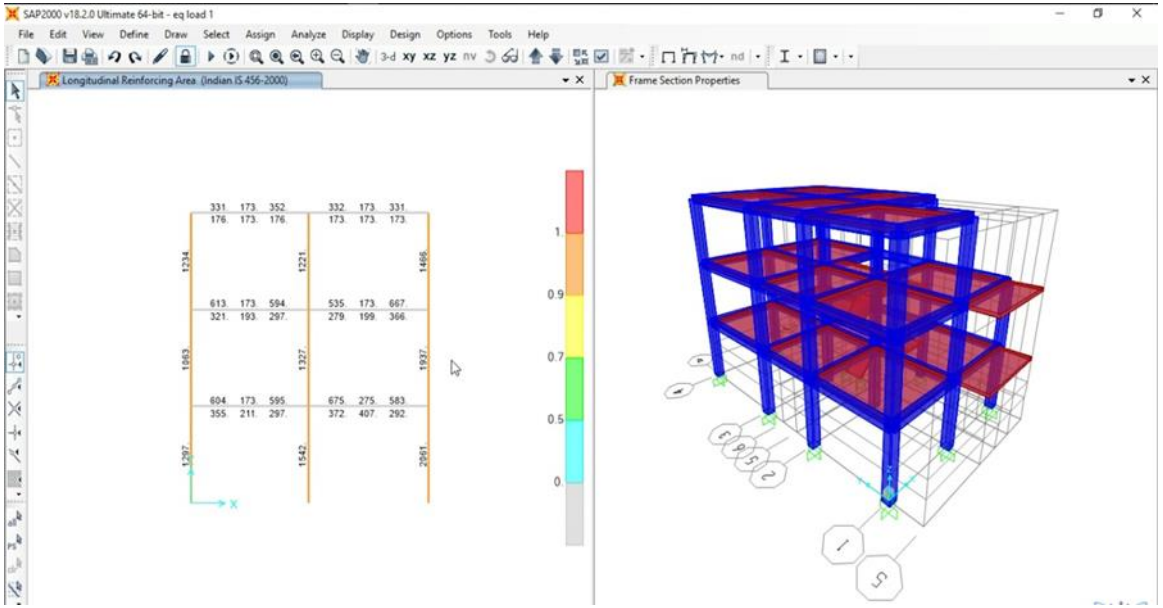
ETABS is an engineering software product that caters to multi-story building analysis and design. Modeling tools and templates, code-based load prescriptions, analysis methods and solution techniques, all coordinate with the grid-like geometry unique to this class of structure.



Pre-construction tools

- Design Tools:
  - Structural Design Tools
    - SAP2000

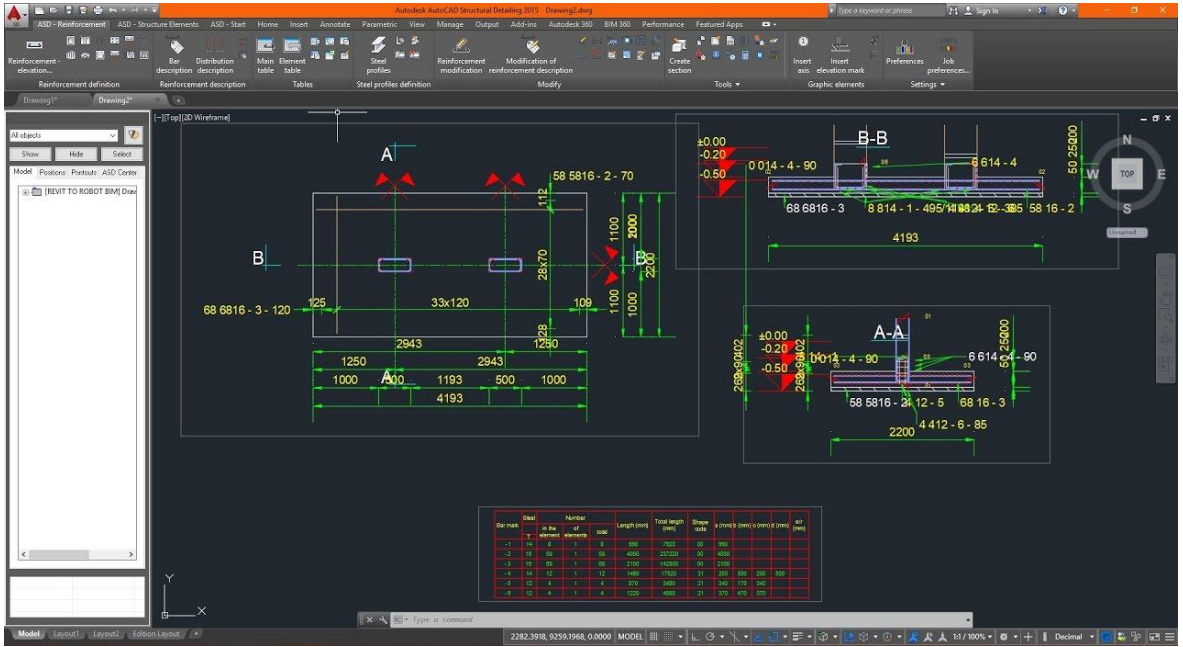
SAP2000 is general-purpose civil
engineering software ideal for the analysis and design of any type of structural system. Created by engineers for effective
engineering, SAP2000 is the ideal software tool for users of any experience level, designing any structural system.



Pre-construction tools

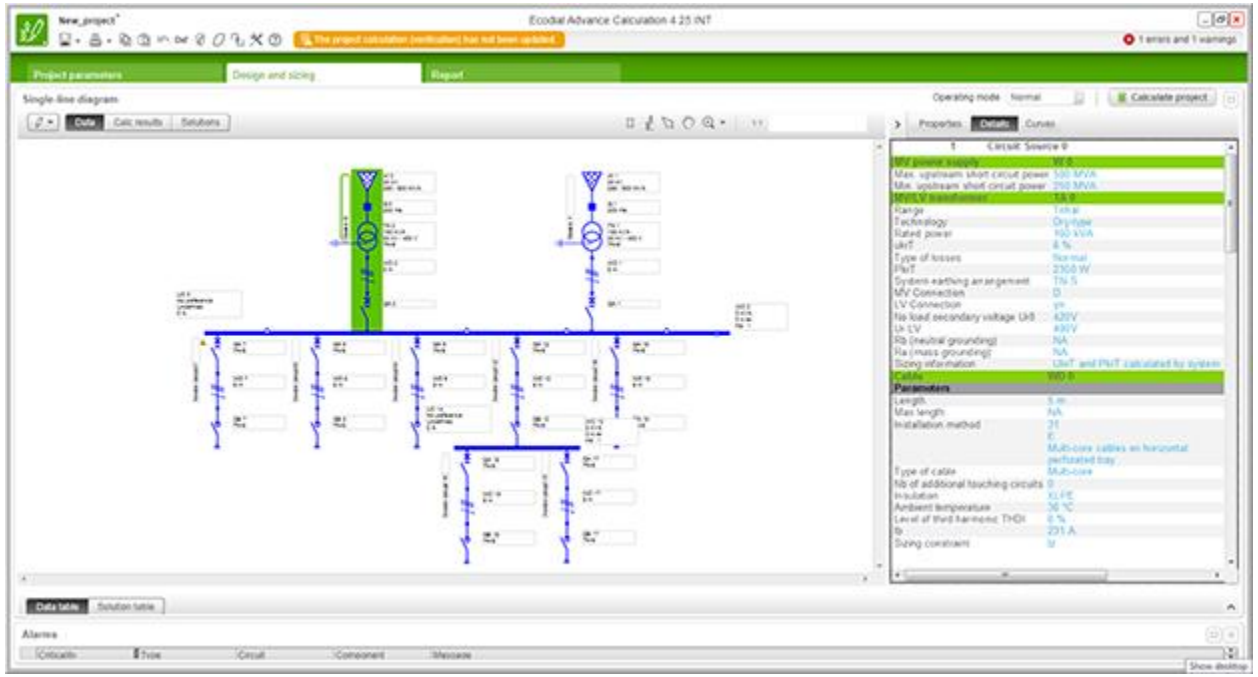
- Design Tools:
  - Structural Design Tools
    - Autodesk AutoCAD

AUTODESK AUTOCAD



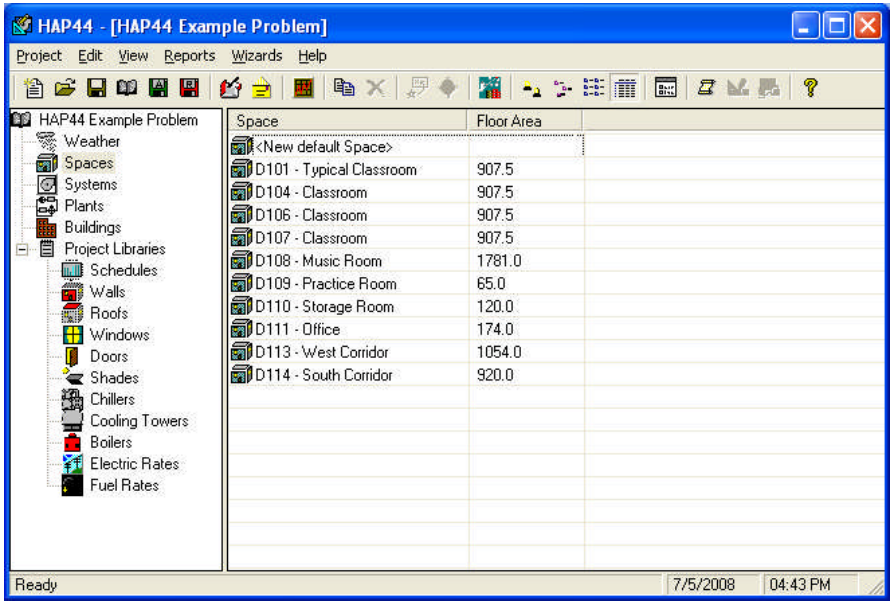
Pre-construction tools

- Design Tools:
  - Utility Design Tools
    - Ecodial Schneider Electric (Electrical Engineering)



Pre-construction tools

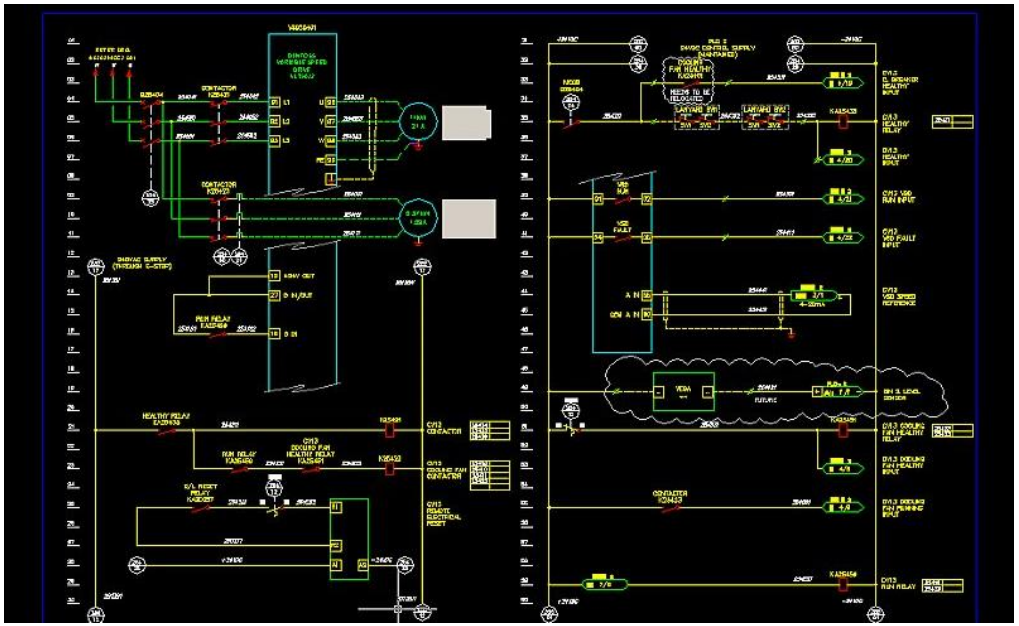
- Design Tools:
  - Utility Design Tools
    - Carrier HAP (Mechanical Engineering)



Pre-construction tools

- Design Tools:
  - Utility Design Tools
    - AutoCAD

AUTODESK AUTOCAD



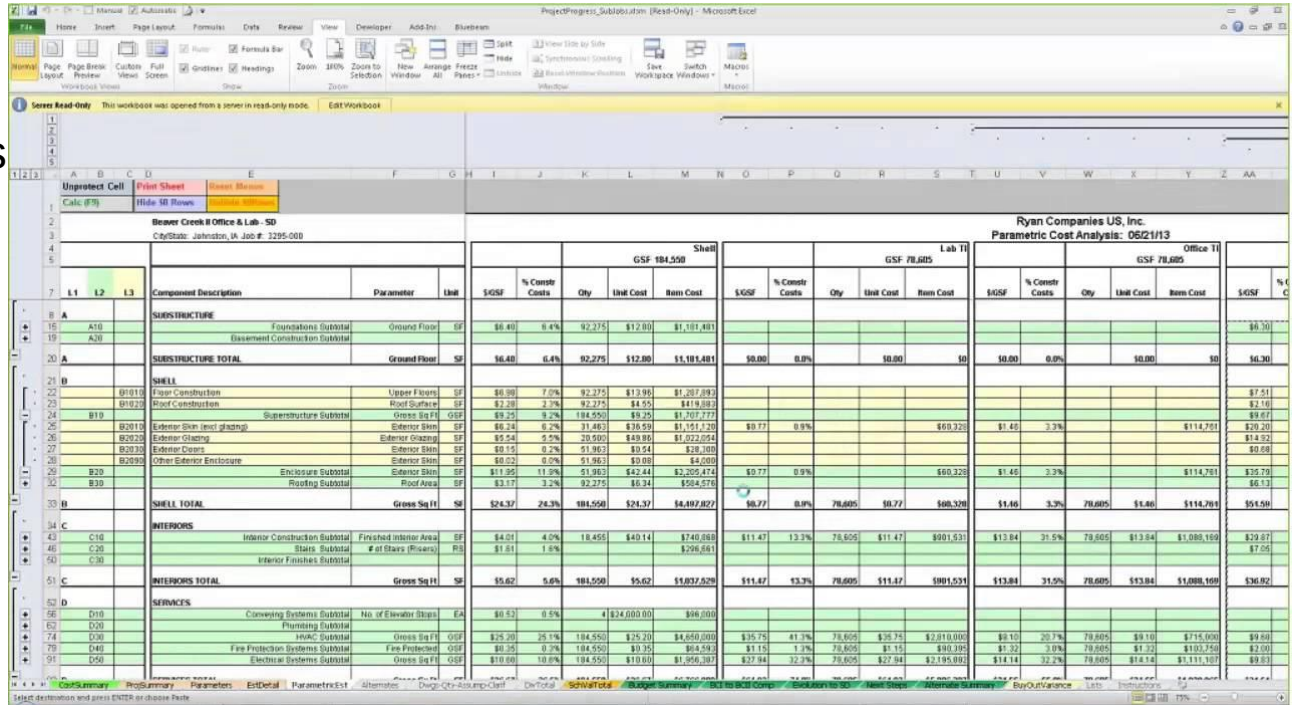
Pre-construction tools

- Design Tools:
  - Design Integration and Clash Detection Tools
    - Pure expert judgement -No computer aided tools

Pre-construction tools

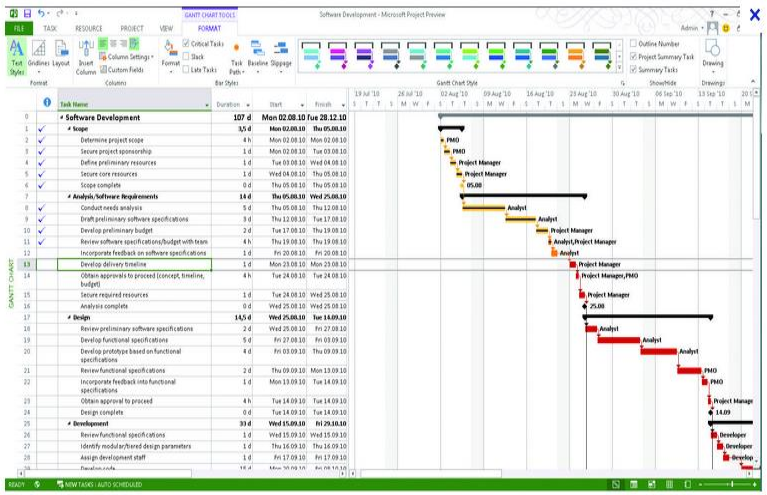
- Estimation Tools
  - Quantity Estimation Tools
    - Mainly expert judgement using on CAD drawings
  - Cost Estimation Tools
    - Cost index

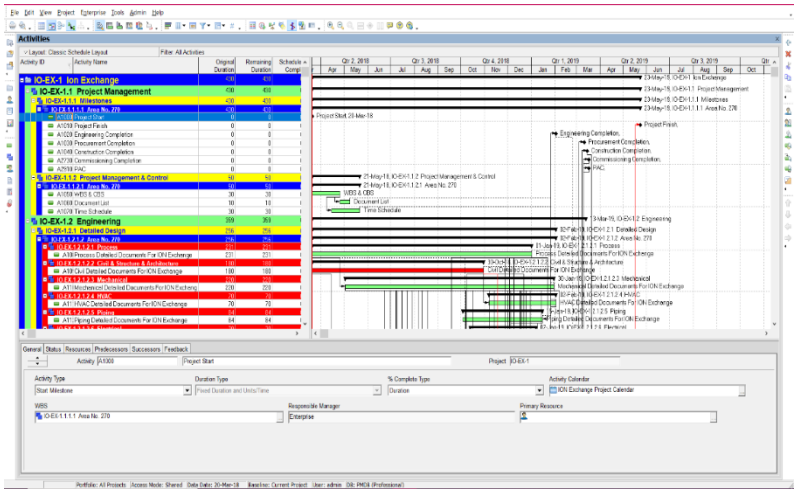
    computer programs
    - Excel sheets



Construction tools

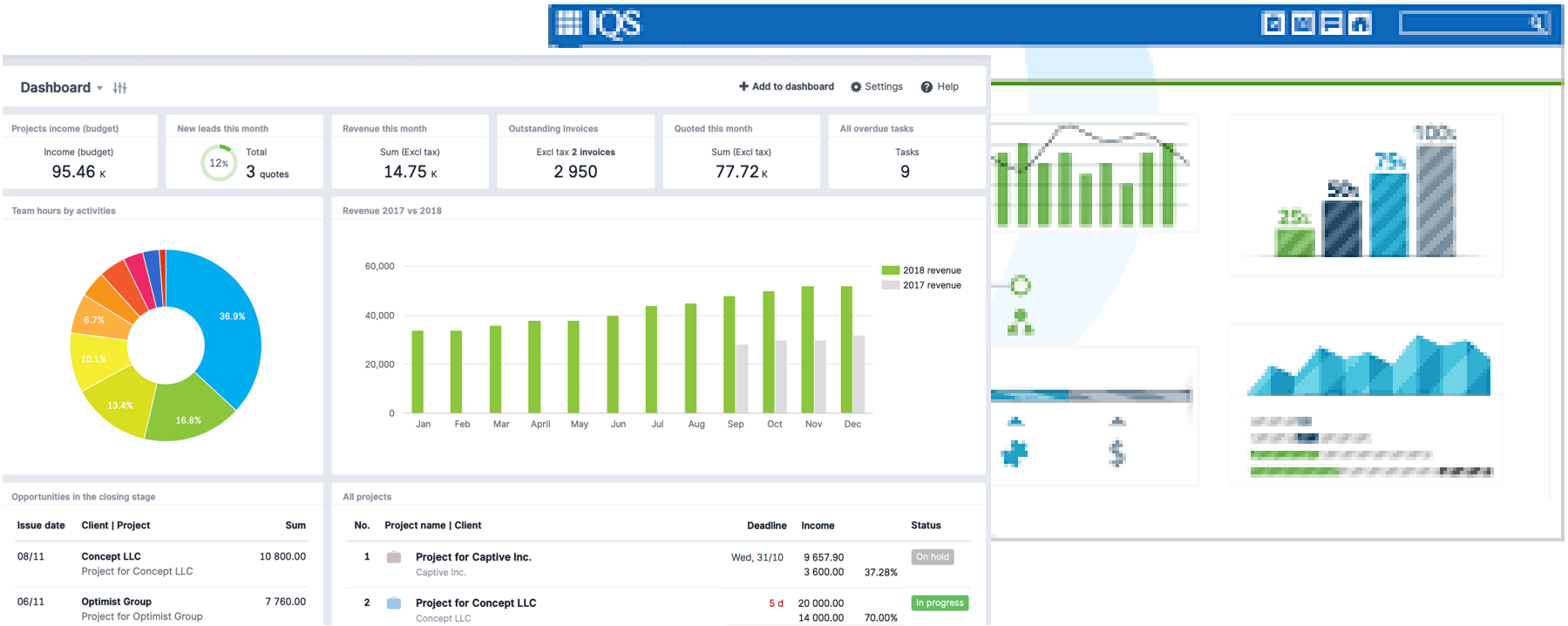
- Progress Control Tools:
  - Scope, Schedule and Budget control Tools
    - MS Project
    - Primavera P6





Construction tools

- Various Construction Activities:
  - Using custom-built computer based management information systems in conjunction with paper forms,

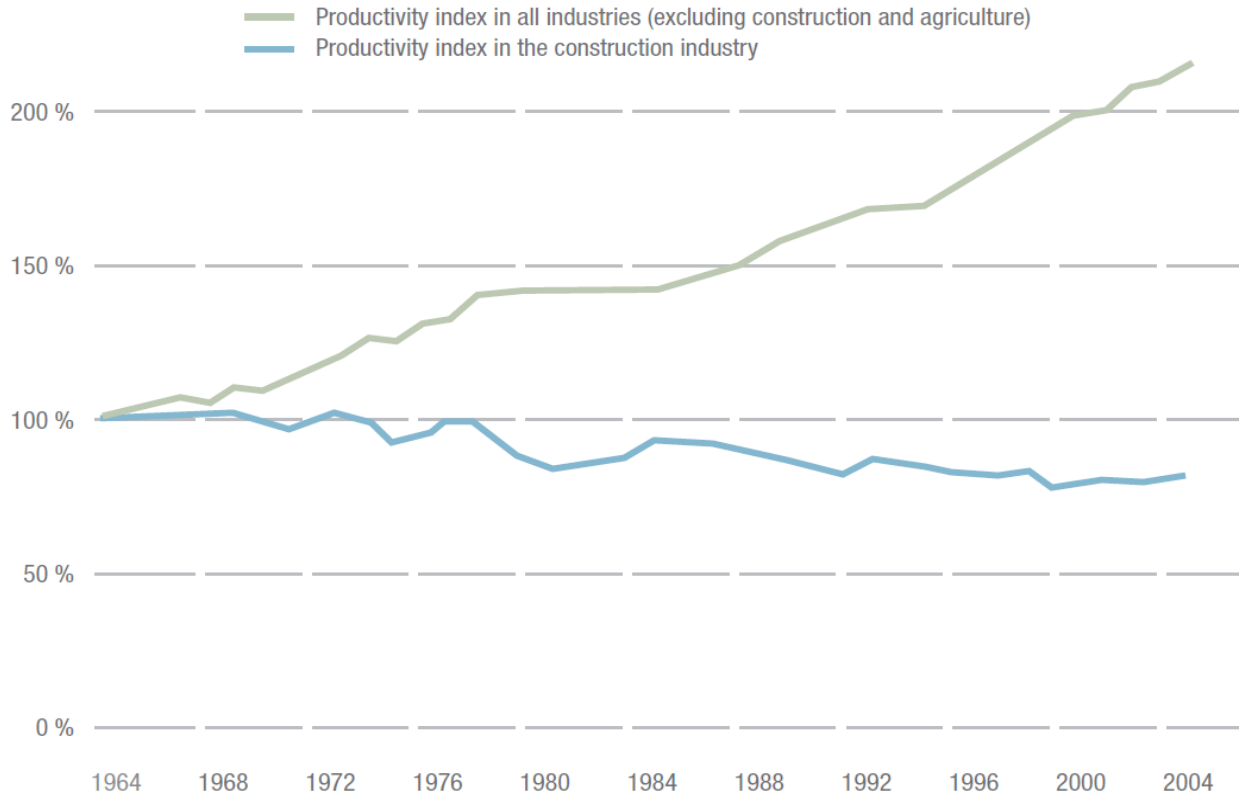


Post-construction tools

- Various Operation and Maintenance Activities:
  - Using custom-built management information system (MIS) computer systems in conjunction with the paper forms

Issues in Conventional Computer Aided Tools

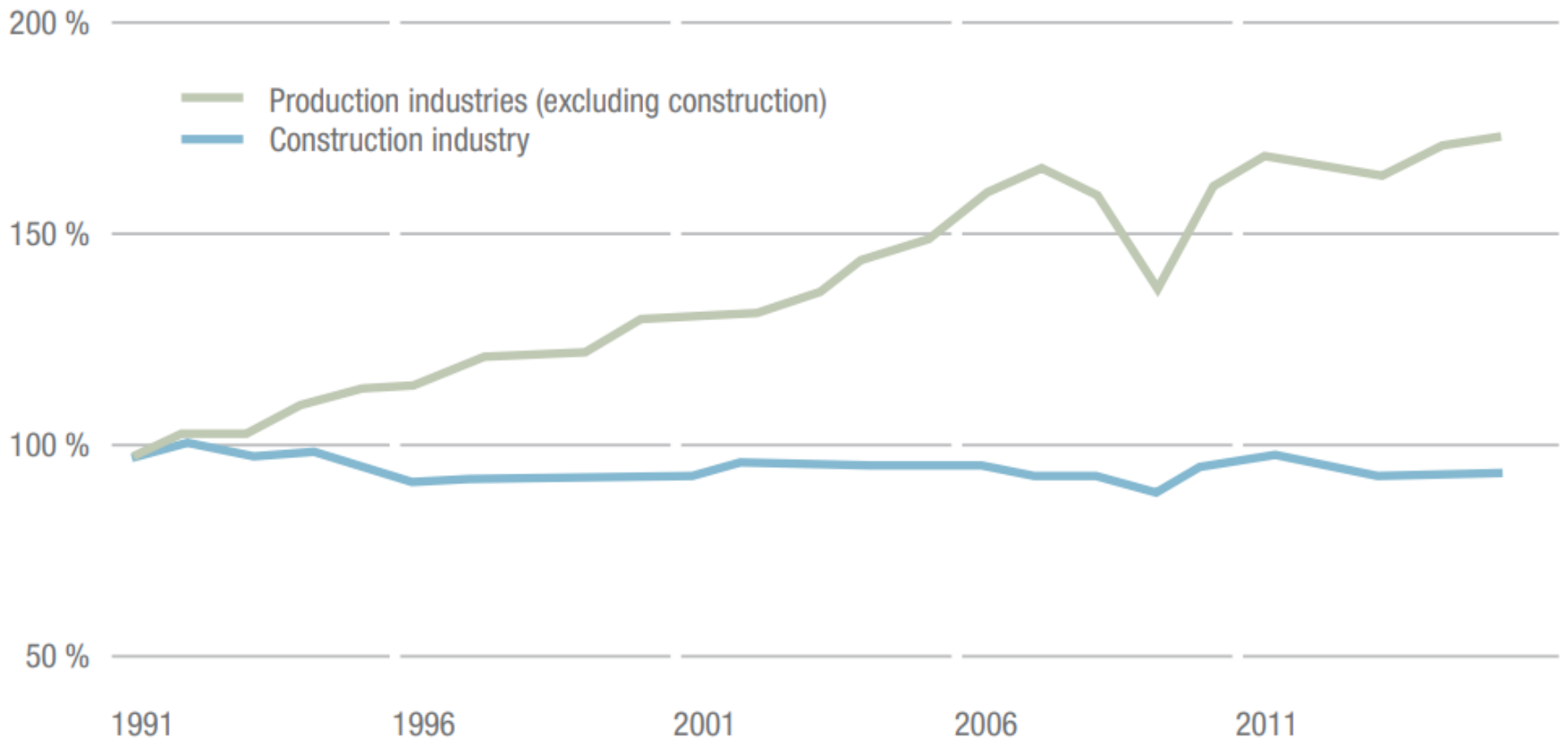
- Traditionally, the construction processes have been fragmented and disconnected using conventional computer aided tools
- Reduced productivity in the construction industry is the result in USA



Source: Teicholz, Ph.D. Paul, Professor (Research) Emeritus, Dept. of Civil and Environmental Engineering, Stanford University

Issues in Conventional Computer Aided Tools

- As well as Germany:



Source: Federal Statistics Office, Germany

Issues in Conventional Computer Aided Tools

Can you name some examples of the current issues resulting in the decreased productivity?

Issues in Conventional Computer Aided Tools

- Some factors created the current condition (Baldwin, 2019):

1. Industry diversity and complexity

The construction industry is continually becoming more complex and fragmented. Each decade brings new specialist disciplines and trades. With each specialization, project requirements become more complicated and communication and decision making is more laborious. Managing communication on large projects is an overwhelming task for the majority of contracting firms – most of these being small companies of less than ten employees.

Issues in Conventional Computer Aided Tools

- Some factors created the current condition (Baldwin, 2019):

2. Manual, inefficient, and outdated processes

Many of our design and construction practices are antiquated. Trades like masonry and carpentry have changed little in the past centuries and will be progressively sidelined by prefabrication and robotic-assisted assembly. Similarly, our drawing conventions are a hangover from the Renaissance period and are no longer a viable means to deliver project information on large developments.

Plans must be accompanied by a mass of additional documentation (building specifications, equipment lists, schedules, operational and maintenance manuals, contracts, variation orders) that supplement, and too often duplicate or contradict what is represented in the drawings. There must be a better way of working!

Issues in Conventional Computer Aided Tools

- Some factors created the current condition (Baldwin, 2019):

3. Technology resistance

The construction industry is, by and large, conservative and has made only tentative steps in adopting new technologies. There are notable exceptions, such as the development of digital fabrication processes (CAD, CAM) in the steel, timber, and other sectors. These developments are, however, typically isolated and have not inspired change across the supply chain.

Issues in Conventional Computer Aided Tools

- Some factors created the current condition (Baldwin, 2019):

4. Conventionally applicable computer aided tools cannot talk to each other

- E.g., Structural design on ETABs are separately drafted by drafters in AutoCAD

Issues in Conventional Computer Aided Tools

- Some factors created the current condition (Baldwin, 2019):

5. Efforts put on developing computer programs for performing former tasks in the early stages are barely developed and move the next stage for the latter tasks

- New drawings are required for the detail design after conceptual design
- Construction drawings need to be put in order manually according to the project plan based on the expert judgement
- Quantities should be manually extracted based on the drawings using the expert judgement

Issues in Conventional Computer Aided Tools

- Some factors created the current condition (Baldwin, 2019):

7. Project documentation is decentralized and mainly based on the paper forms

8. Limited gathered knowledge during preconstruction and construction phases is transferred to the post-construction, i.e., operation and maintenance phase

Additional time and cost is the result

BIM, New Approach to Address Construction Issues

Current situation of construction industry

Digital technologies are transforming our lives. The Internet is now irreplaceable to most of our business processes.

With the proliferation of smartphones and other mobile devices, digital connectedness has altered almost every aspect of our professional and private interactions. It has changed them way we communicate, bank, shop, plan holidays, learn, share opinions and engage with our peers (Baldwin, 2019).

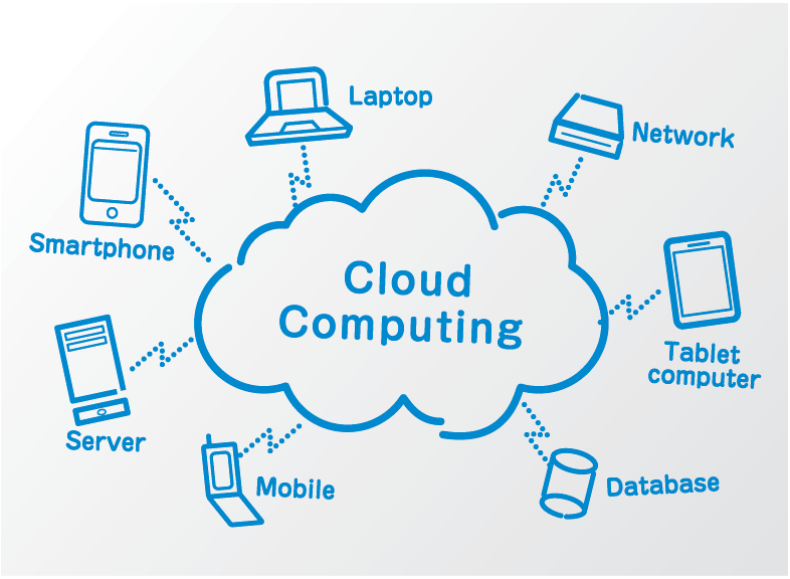
Improvement methods

So, how can we address these issues, and which role does Building Information Modelling play?

There is no reversing industry fragmentation. Rather, we should *embrace* specialization by enabling **communication and information sharing in a networked, flexible, and agile manner**. **New processes** need to be adopted that remove antiquated workflows and support integrated, digital ways of working. And a **cultural change** needs to take place in order to shift our perception and use of technology (Baldwin, 2019).

Improvement methods

Many of the technologies we need for this digital transformation already exist: **cloud computing**, **mobile devices**, **digital fabrication technologies**, and **GPS-controlled site equipment**, to name a few. We simply need to make the use of them more commonplace (Baldwin, 2019).



Cloud computing refers to data processing that takes place remotely (in data centres), not in our PCs. Personal Computers and mobile devices access the applications over the internet, while the actual computing takes place in the 'cloud'.

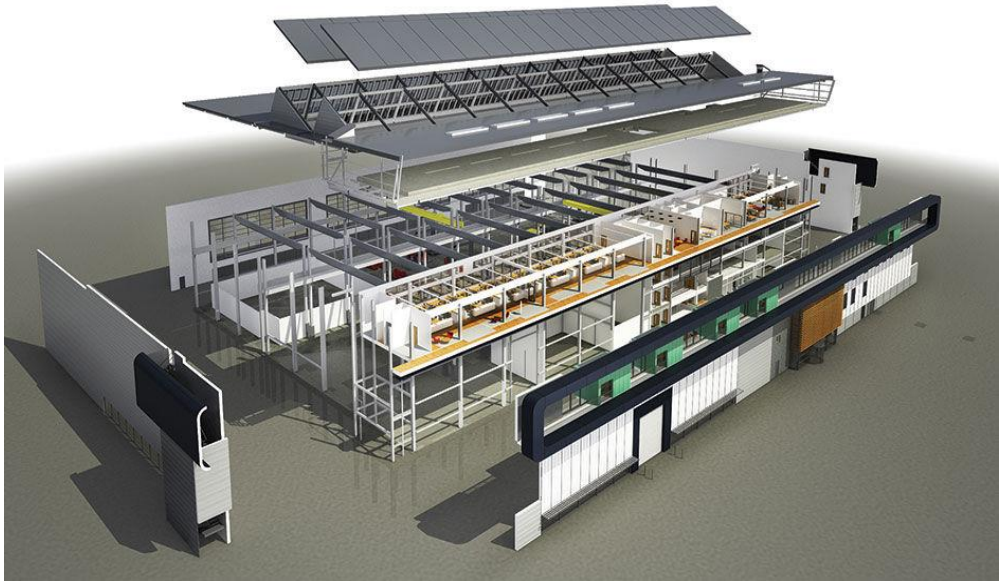
BIM is the Answer!

The new construction world's response to overcome the current issues is:

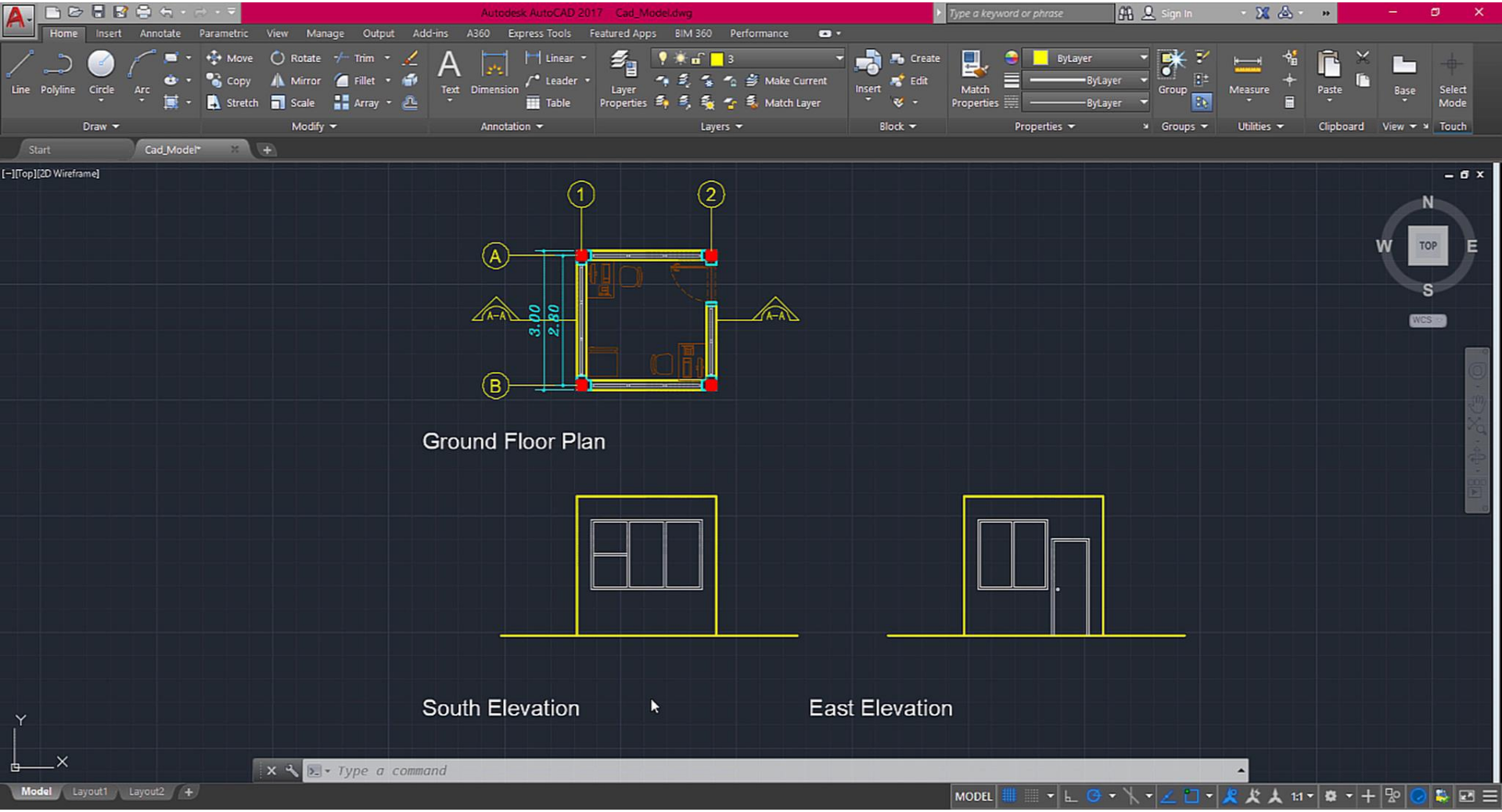
Building Information Modeling (BIM)

What is BIM?

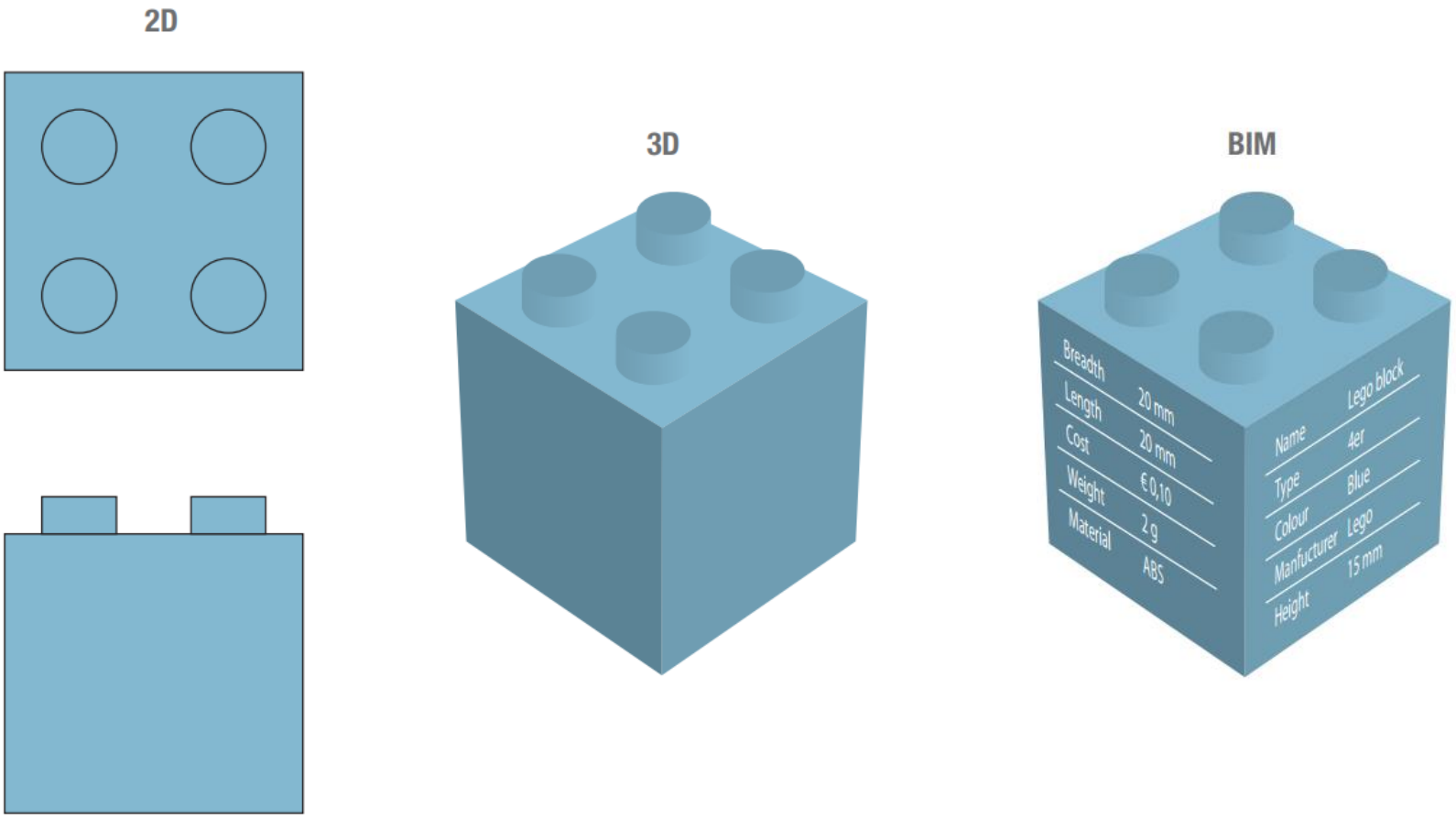
- Building Information Modeling (BIM) is an object oriented three dimensional (3D) simulation of the project components which is shared among different stakeholders in the design, construction and maintenance phases.



Object oriented feature of BIM

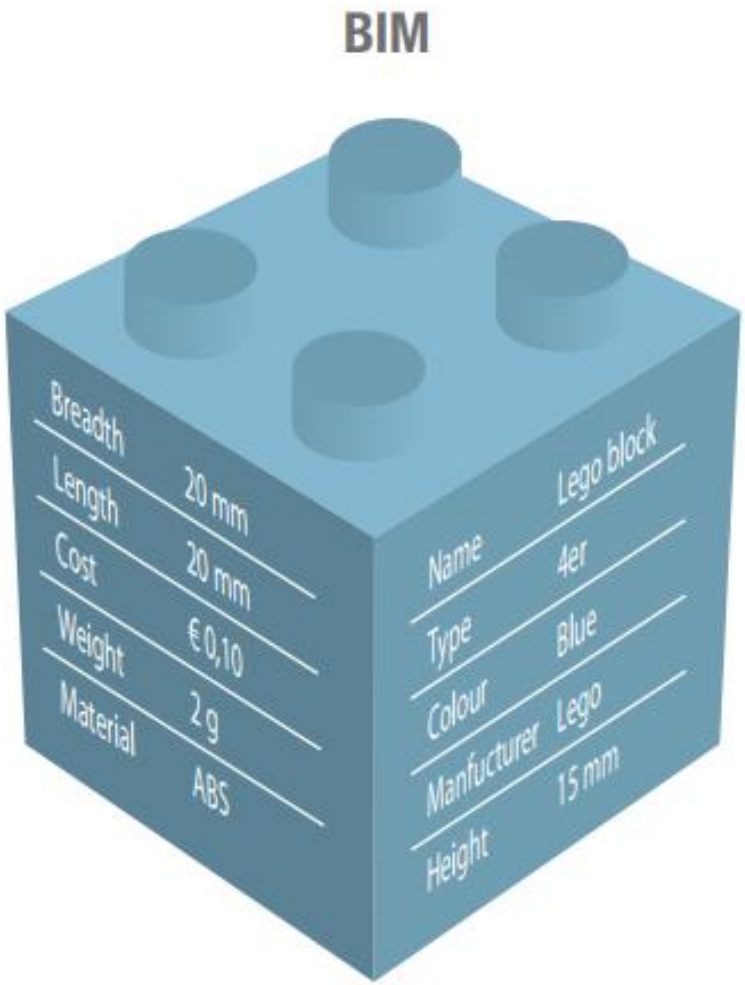


2D CAD transition to 3D BIM



Lego analogy (Baldwin, 2019)

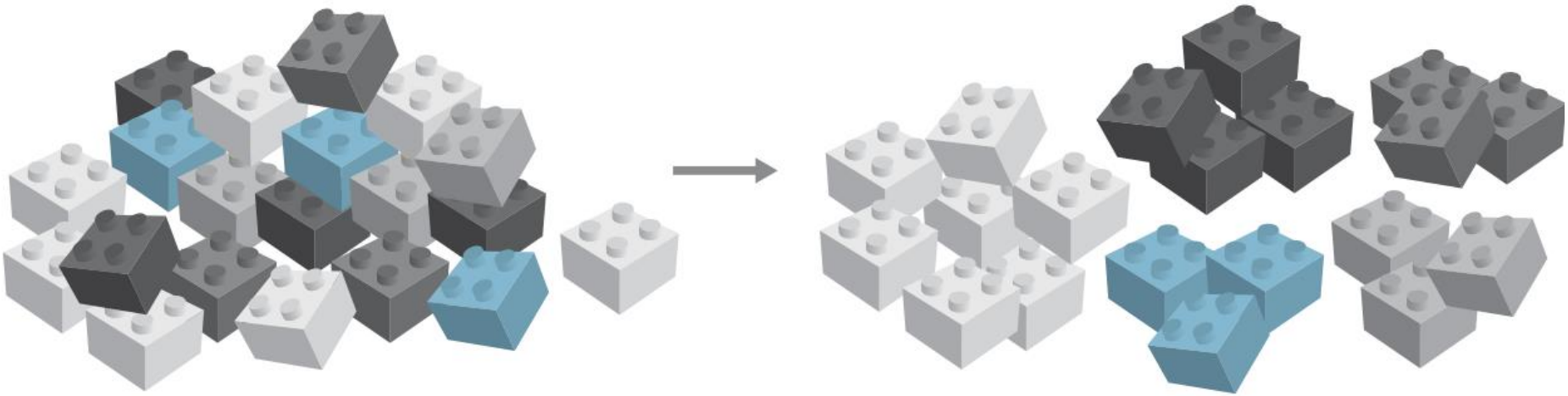
2D CAD transition to 3D BIM



Searching and sorting feature in BIM

- One feature of object properties is the filtering mechanism which helps quick identification of various object instances based on there characteristics. Necessary studies can then be performed based on different characteristics (Baldwin, 2019).

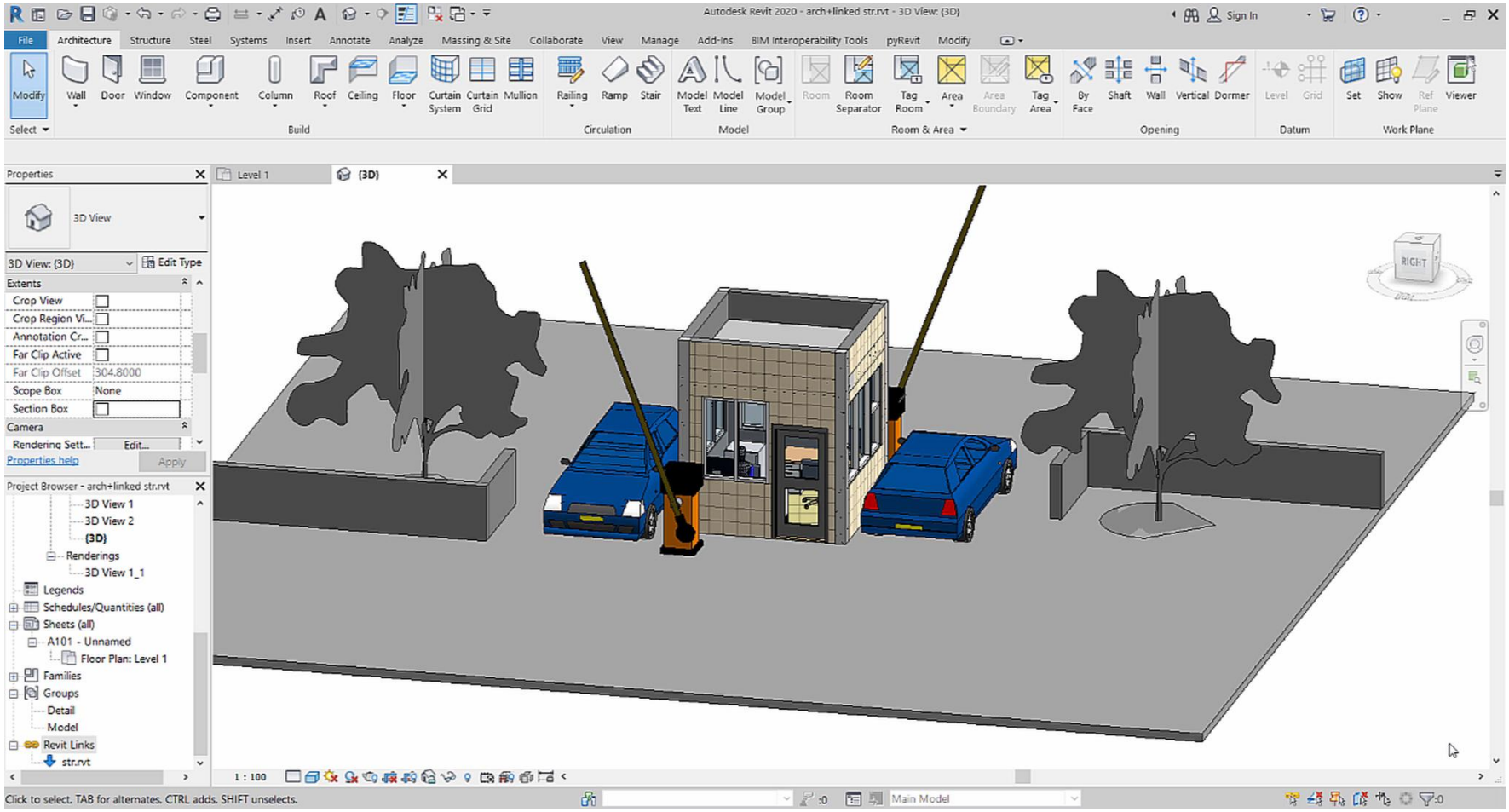
Searching and sorting feature in BIM



(Lego analogy)

Object properties enable powerful search and sorting functions (Baldwin, 2019).

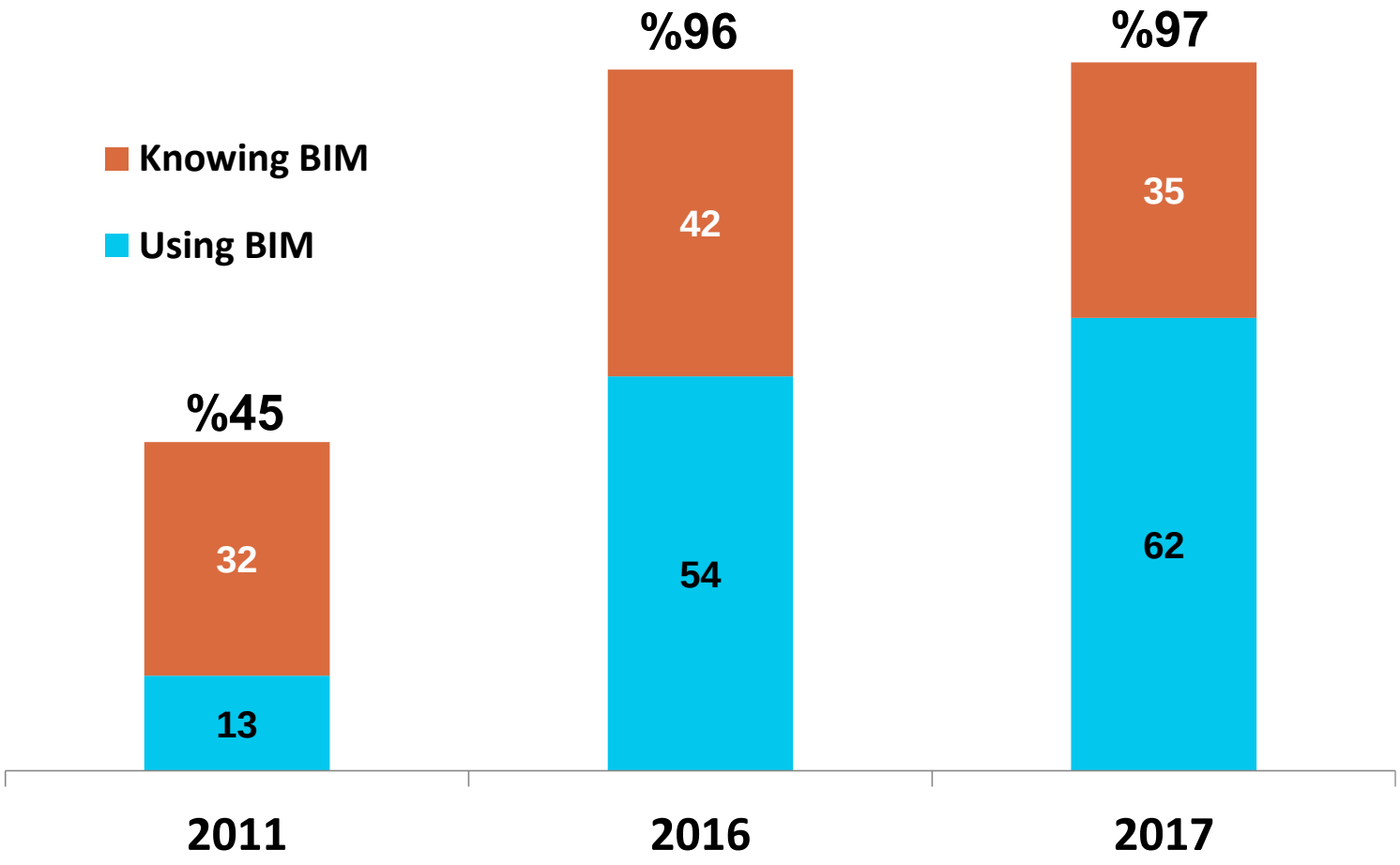
Searching and sorting feature in BIM



Necessity of BIM

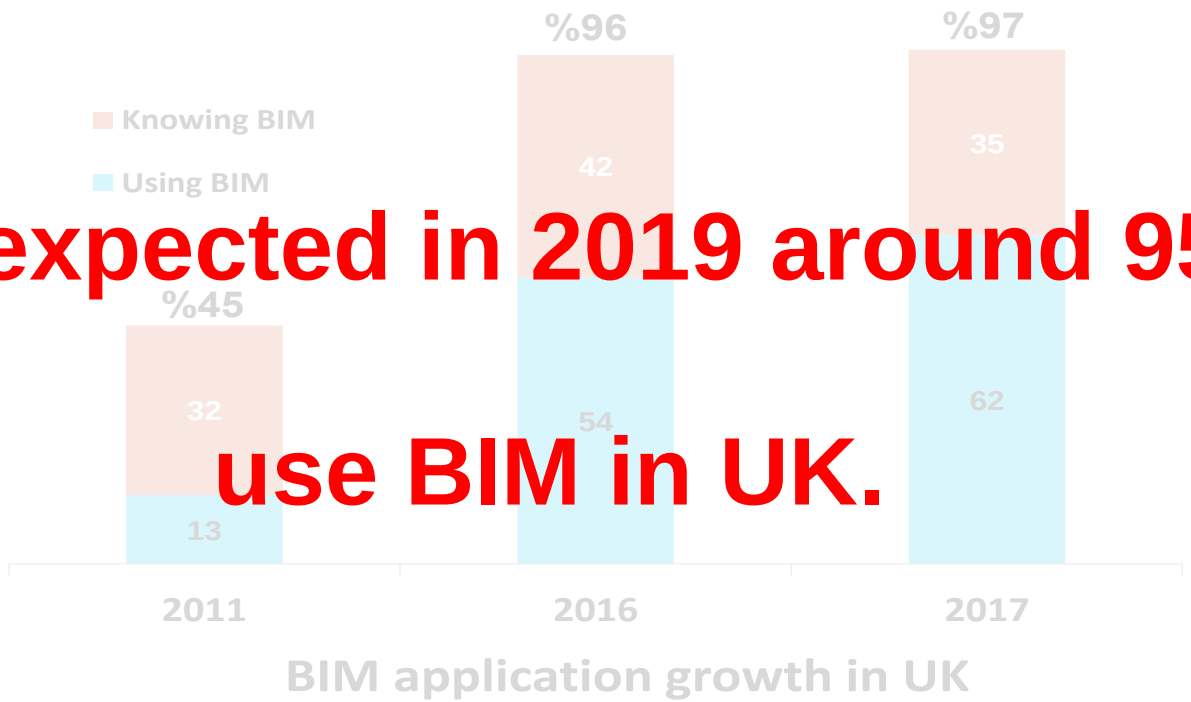
- A powerful tool for improving project management and implementation
- Avoided duplication and waste of resources
- Increased pace of the project construction
- Reduced construction and maintenance cost in large and complex construction projects compared to the traditional implementation methods
- The rapid improvement of information technology requires construction project clients to bring along with the pace of advances

BIM applications growth



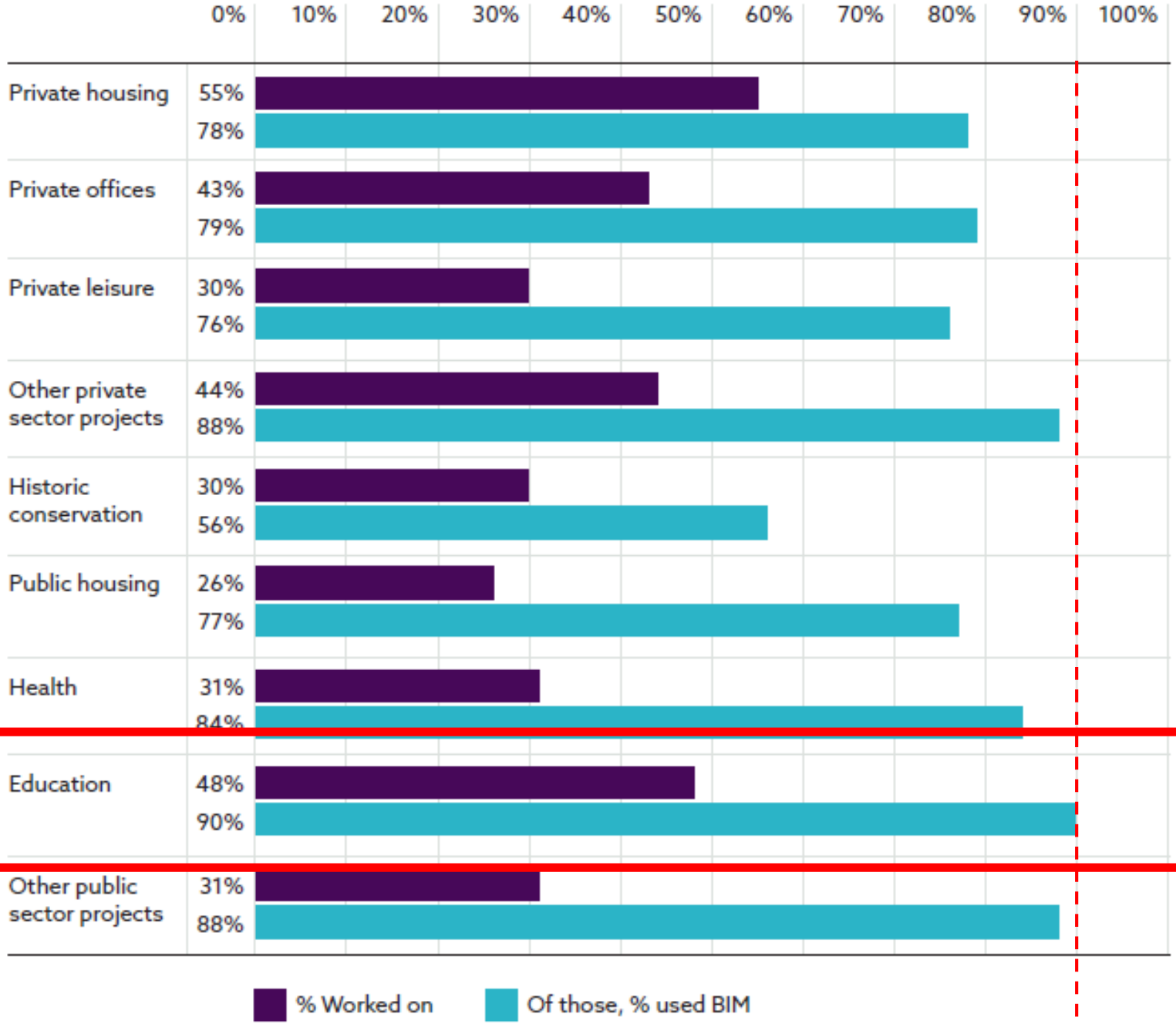
BIM application growth in UK

BIM applications growth



It is expected in 2019 around 95%

use BIM in UK.

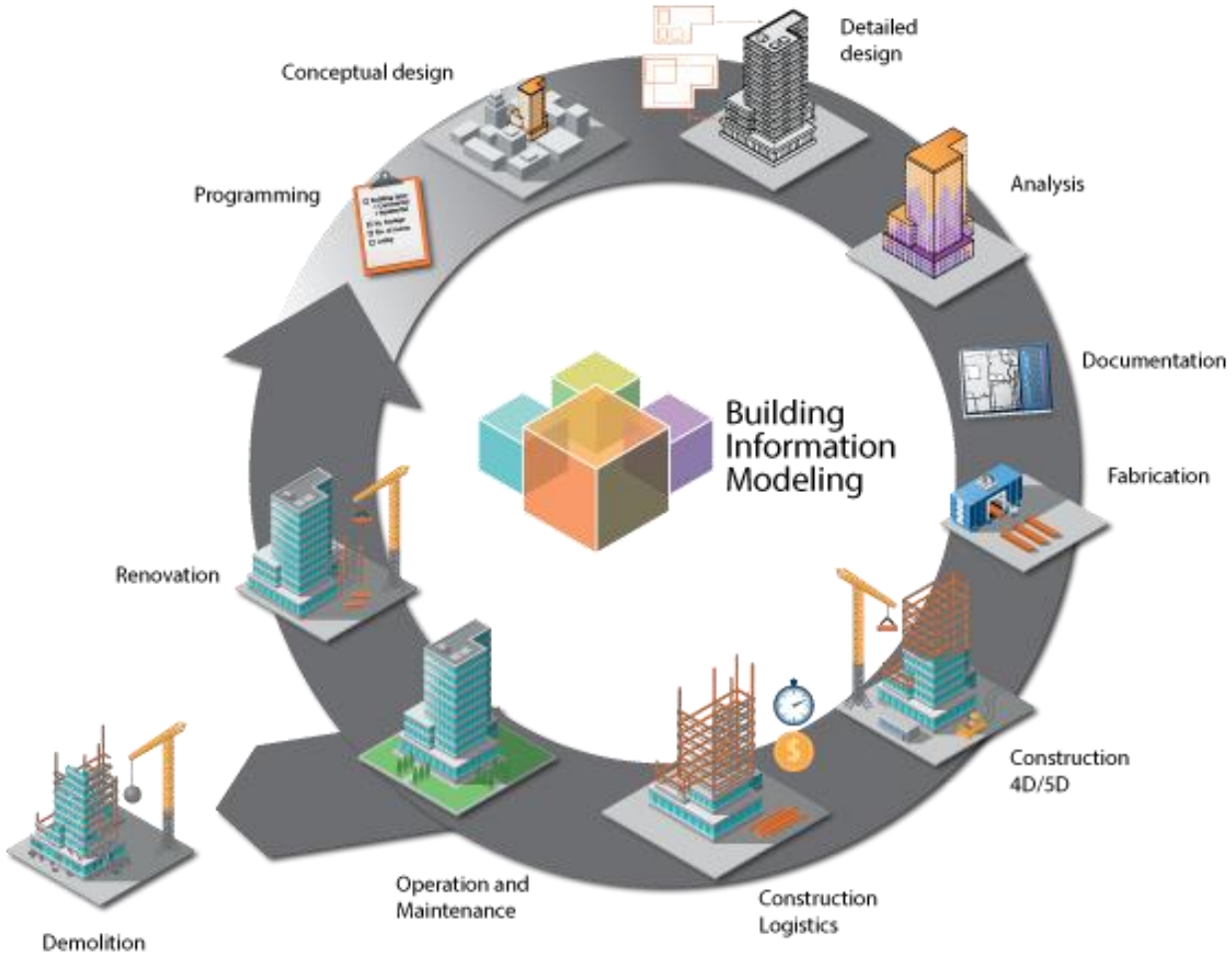

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Private housing
55%
78%
Private offices
43%
79%
Private leisure
30%
76%
Other private sector projects
44%
88%
Historic conservation
30%
56%
Public housing
26%
77%
Health
31%
84%
Education
48%
90%
Other public sector projects
31%
88%
% Worked on
Of those, % used BIM

BIM in different countries

- UK
  - The British government in 2007 stipulated that all public-funded public projects should "use" BIM by 2016. UK has become an example for other countries.
- USA
  - The use of BIM in construction projects began in the country since about 2000.
- Australia
  - Air Conditioning and Mechanical Contractors' Association (AMCA) in 2016 proposed mandating of using BIM in construction projects in Australia. The association estimates 10% to 30% reduction in costs during construction and maintenance.
- Scandinavian
  - For the BIM, regulations have been developed in Scandinavian countries.

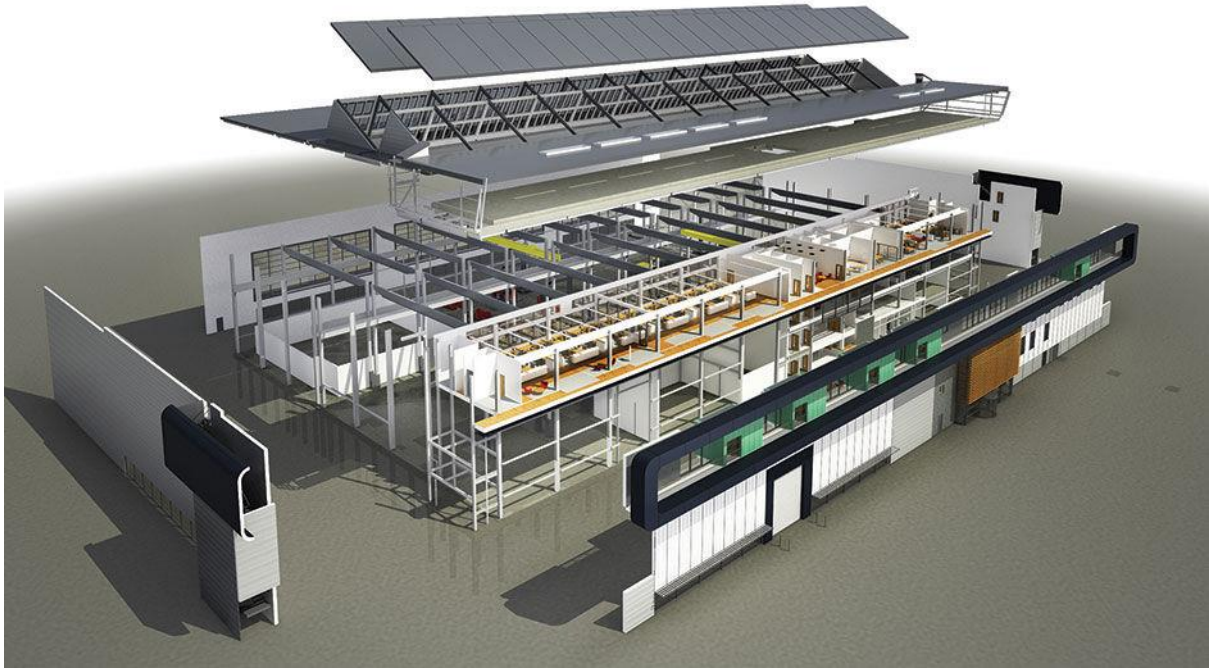
BIM Capabilities in Different Project Phases

BIM capabilities in different project phases



Design phase

- Integrated design

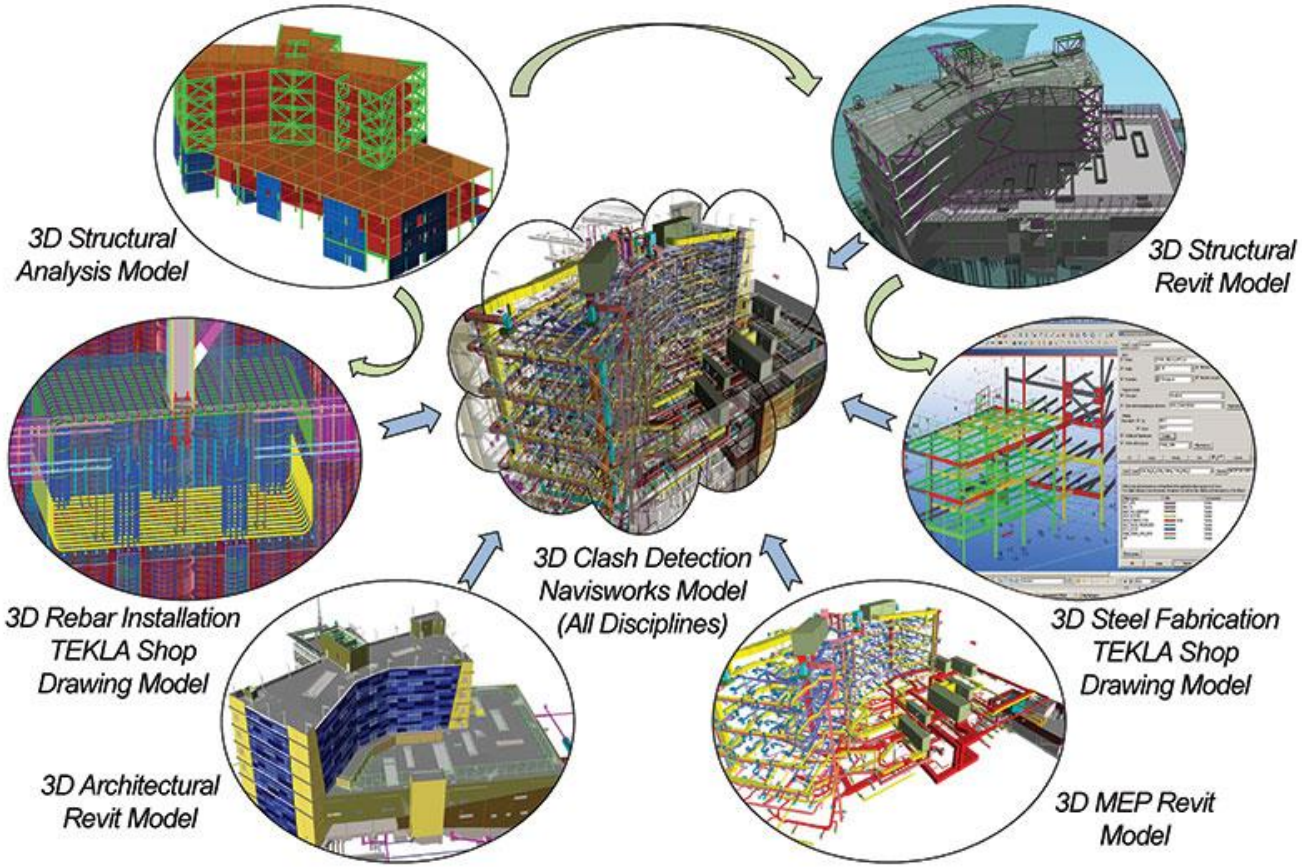


Design phase

- Stakeholders participation in the design reviews

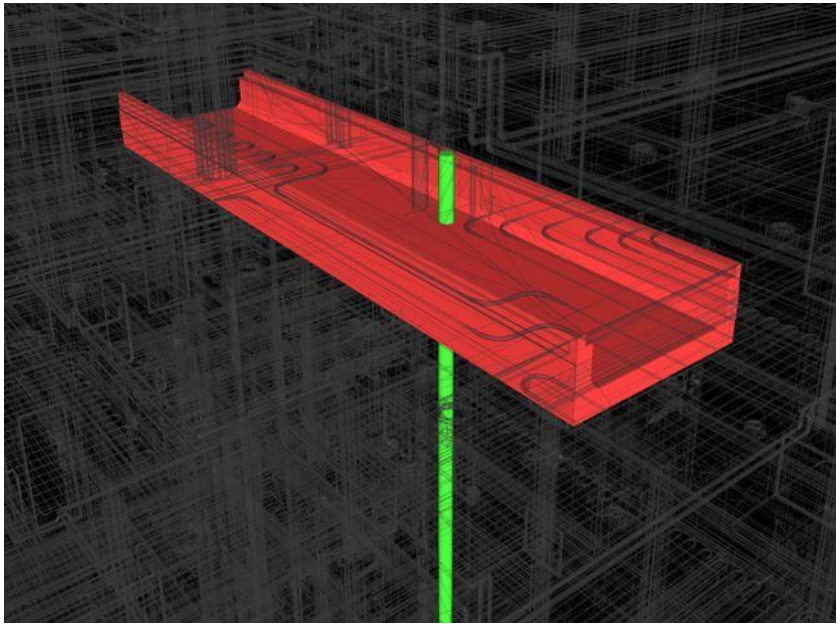
Design phase

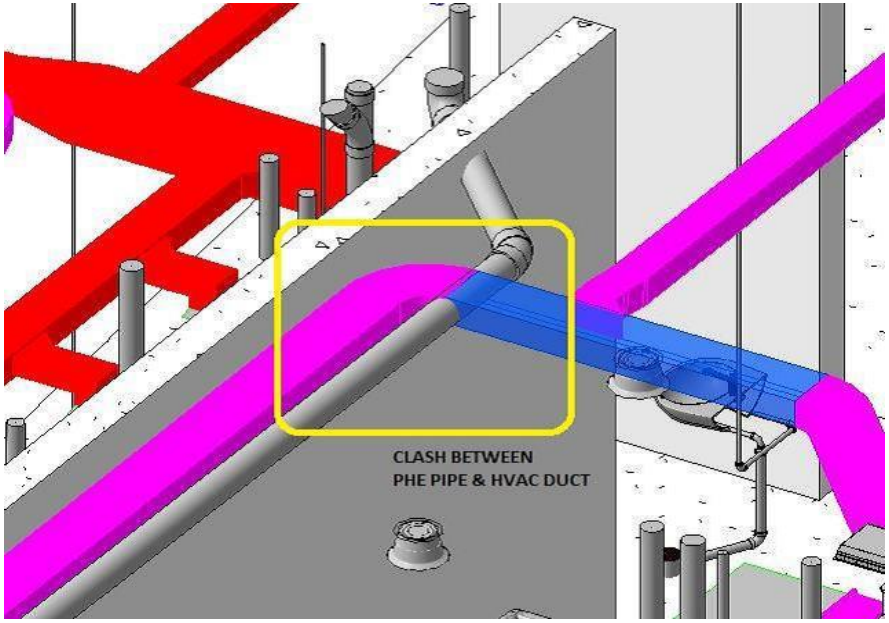
- Constructability reviews



Design phase

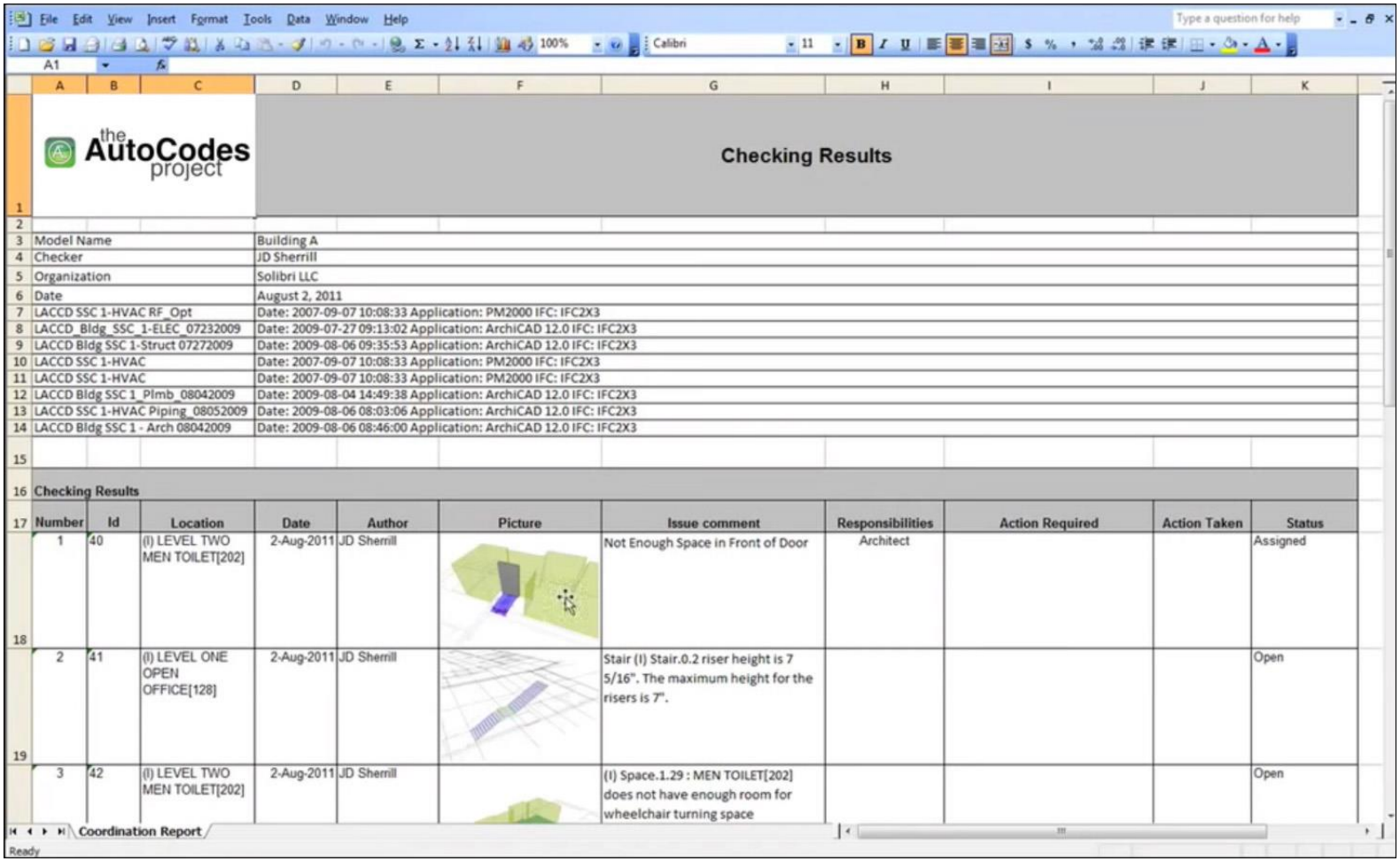
- Clash detection and clash removal





Design phase

- Controlling design codes



the AutoCodes project

Checking Results

Model Name	Building A
Checker	JD Sherrill
Organization	Solibri LLC
Date	August 2, 2011
LACCD SSC 1-HVAC RF_Opt	Date: 2007-09-07 10:08:33 Application: PM2000 IFC: IFC2X3
LACCD_Bldg_SSC_1-ELEC_07232009	Date: 2009-07-27 09:13:02 Application: ArchiCAD 12.0 IFC: IFC2X3
LACCD Bldg SSC 1-Struct 07272009	Date: 2009-08-06 09:35:53 Application: ArchiCAD 12.0 IFC: IFC2X3
LACCD SSC 1-HVAC	Date: 2007-09-07 10:08:33 Application: PM2000 IFC: IFC2X3
LACCD SSC 1-HVAC	Date: 2007-09-07 10:08:33 Application: PM2000 IFC: IFC2X3
LACCD Bldg SSC 1_Plmb_08042009	Date: 2009-08-04 14:49:38 Application: ArchiCAD 12.0 IFC: IFC2X3
LACCD SSC 1-HVAC Piping_08052009	Date: 2009-08-06 08:03:06 Application: ArchiCAD 12.0 IFC: IFC2X3
LACCD Bldg SSC 1 - Arch 08042009	Date: 2009-08-06 08:46:00 Application: ArchiCAD 12.0 IFC: IFC2X3

Checking Results

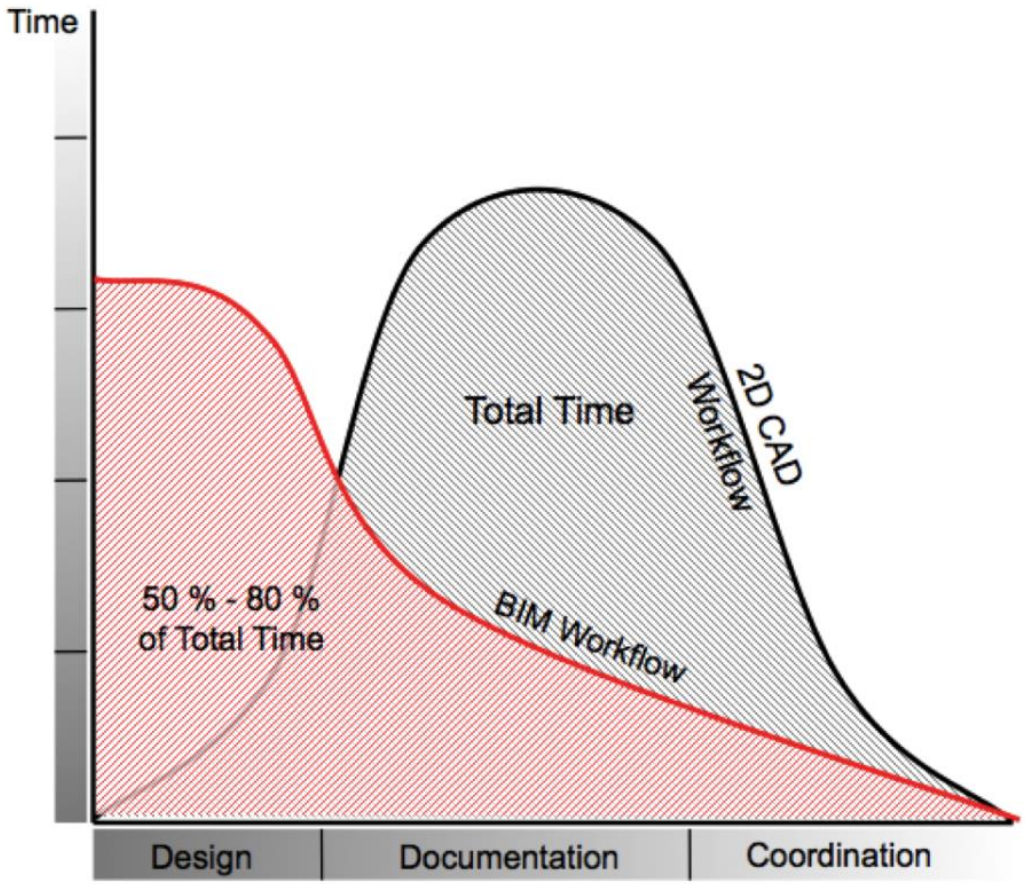
Number	Id	Location	Date	Author	Picture	Issue comment	Responsibilities	Action Required	Action Taken	Status
1	40	(I) LEVEL TWO MEN TOILET[202]	2-Aug-2011	JD Sherrill		Not Enough Space in Front of Door	Architect			Assigned
2	41	(I) LEVEL ONE OPEN OFFICE[128]	2-Aug-2011	JD Sherrill		Stair (I) Stair.0.2 riser height is 7 5/16". The maximum height for the risers is 7".				Open
3	42	(I) LEVEL TWO MEN TOILET[202]	2-Aug-2011	JD Sherrill		(I) Space.1.29 : MEN TOILET[202] does not have enough room for wheelchair turning space				Open

Coordination Report

Ready

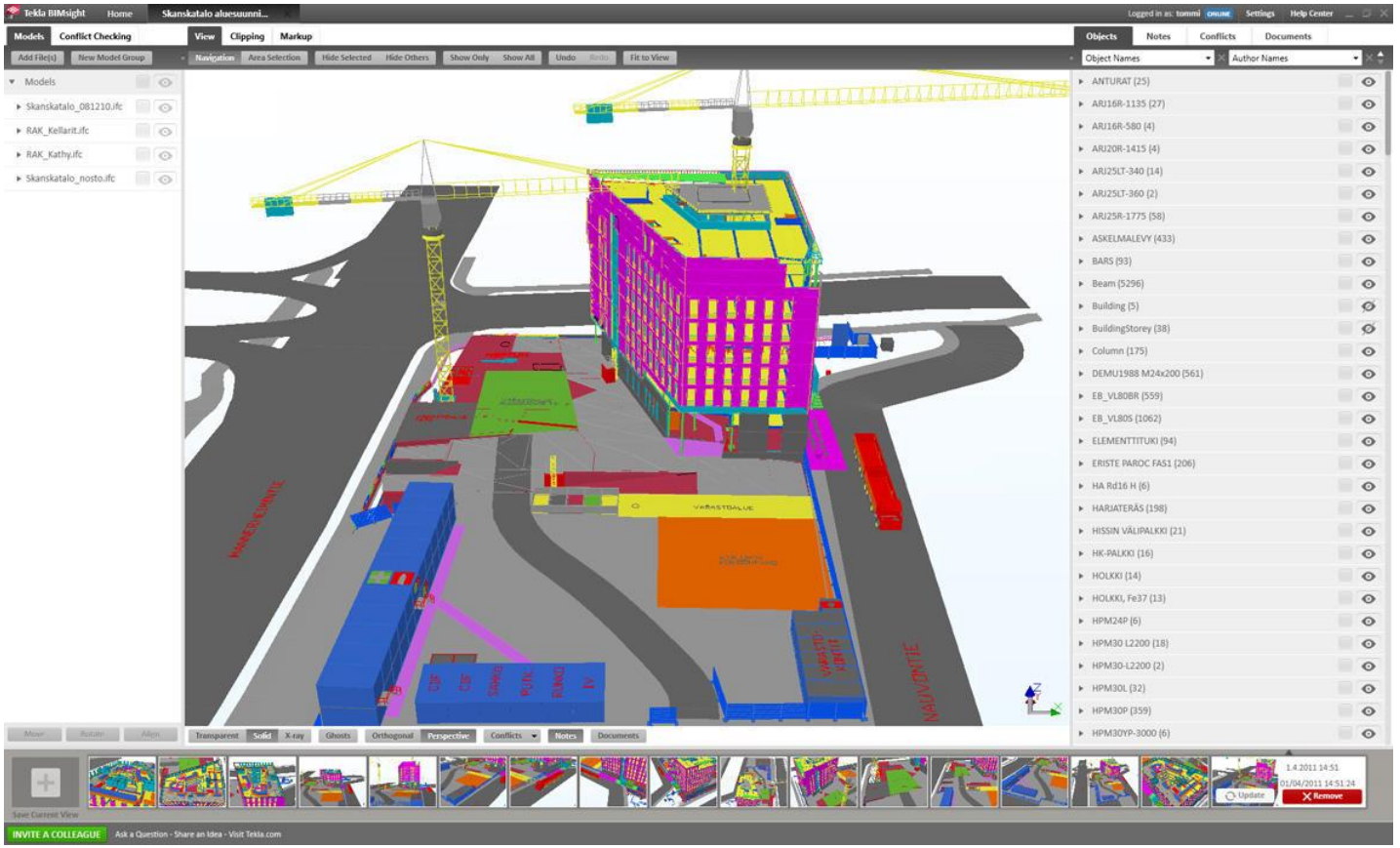
Design phase

- Quantity take off and cost estimation



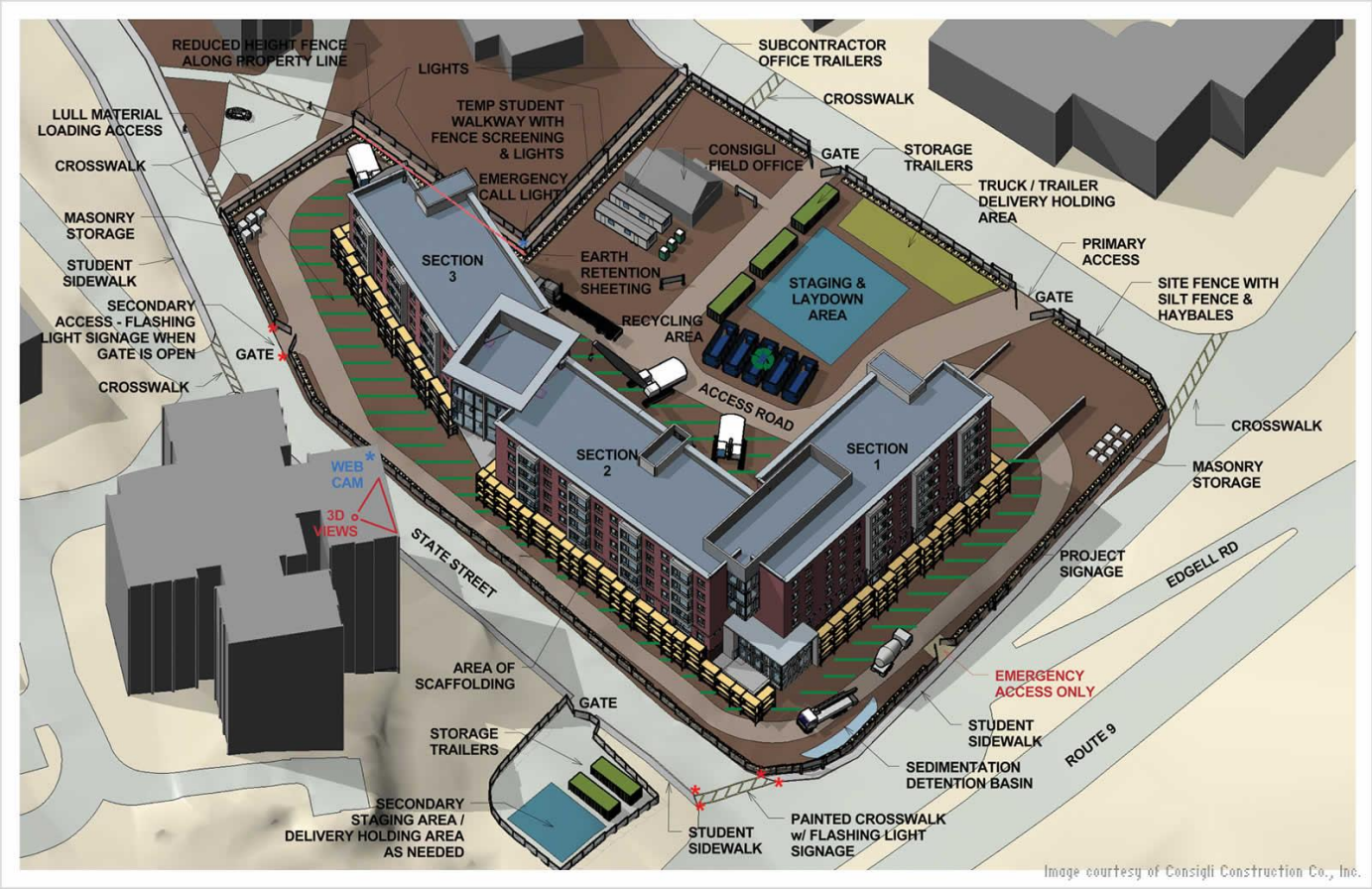
Construction phase

- Mobilization planning



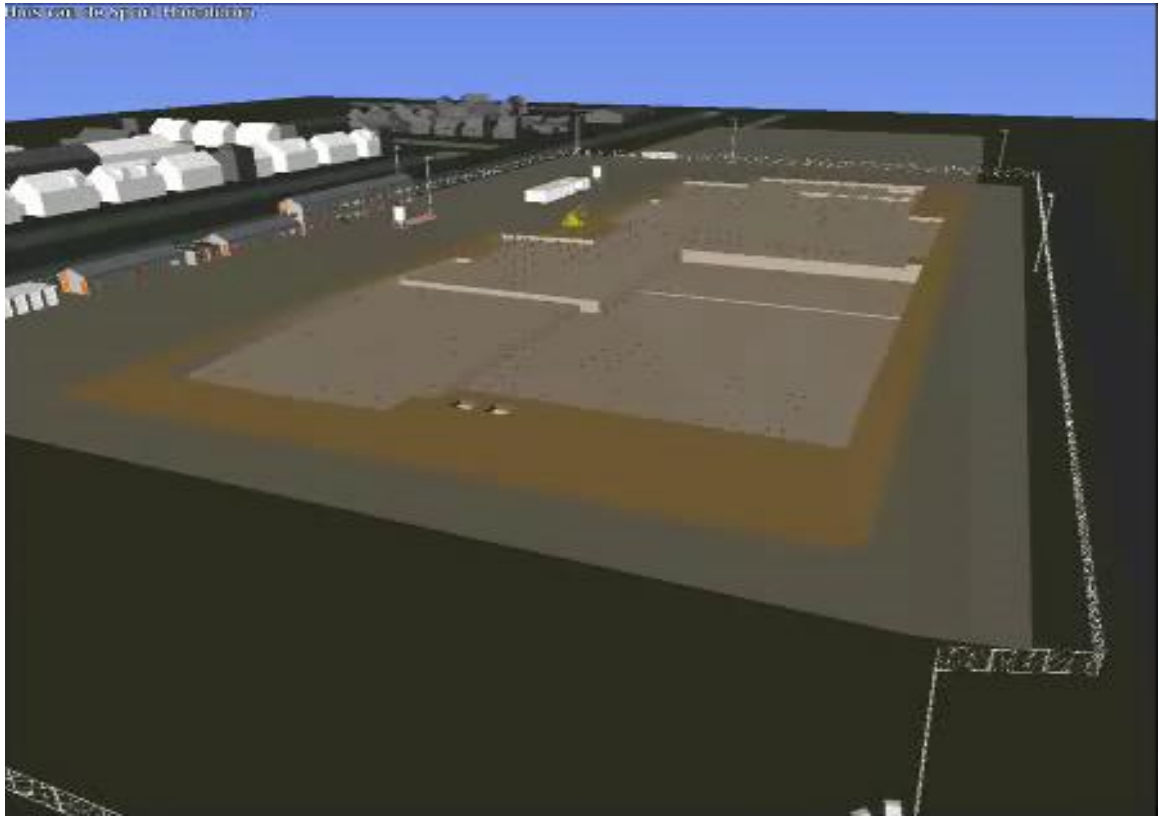
Construction phase

- Analyzing construction site layout



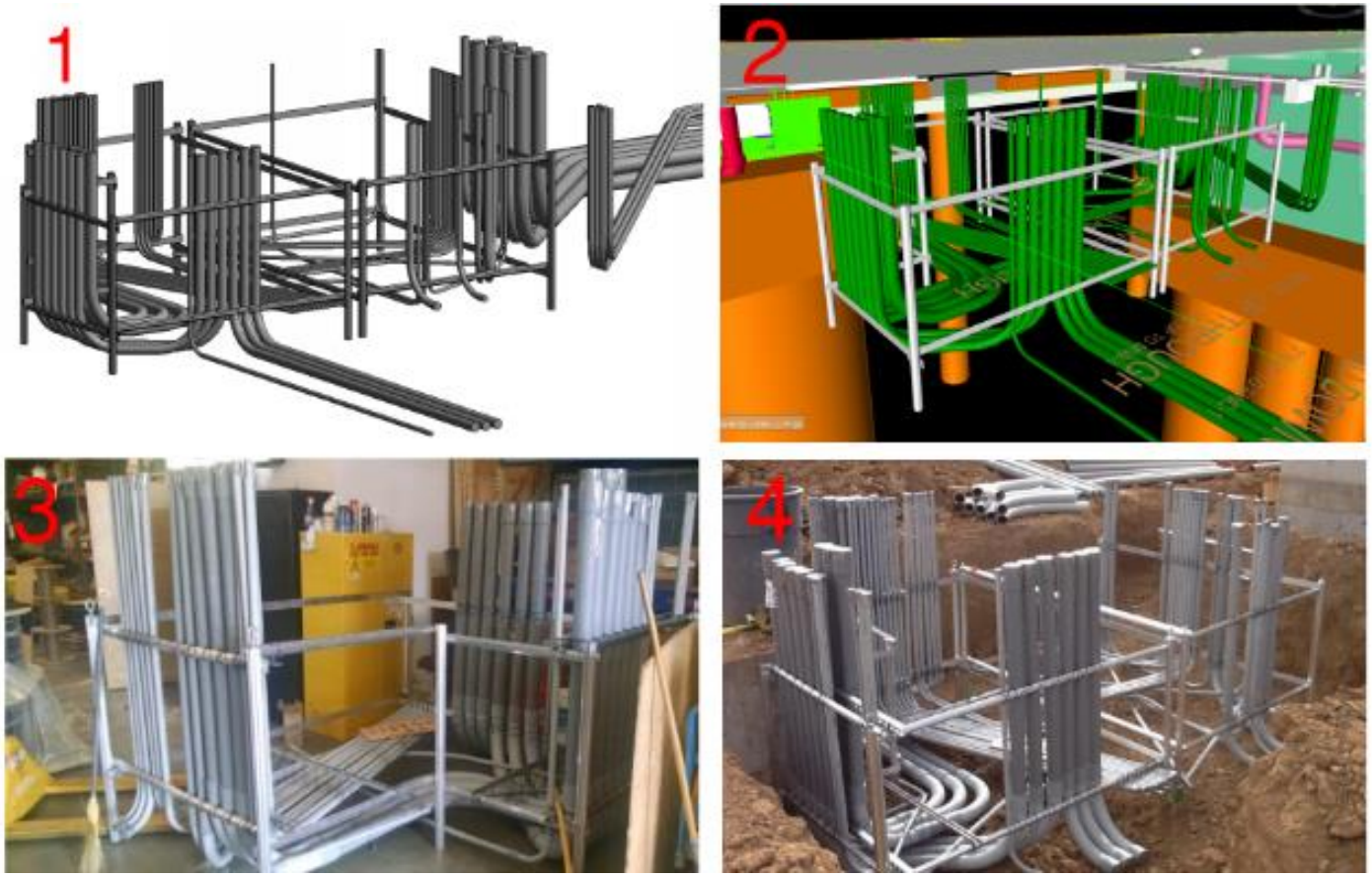
Construction phase

- 4D modeling



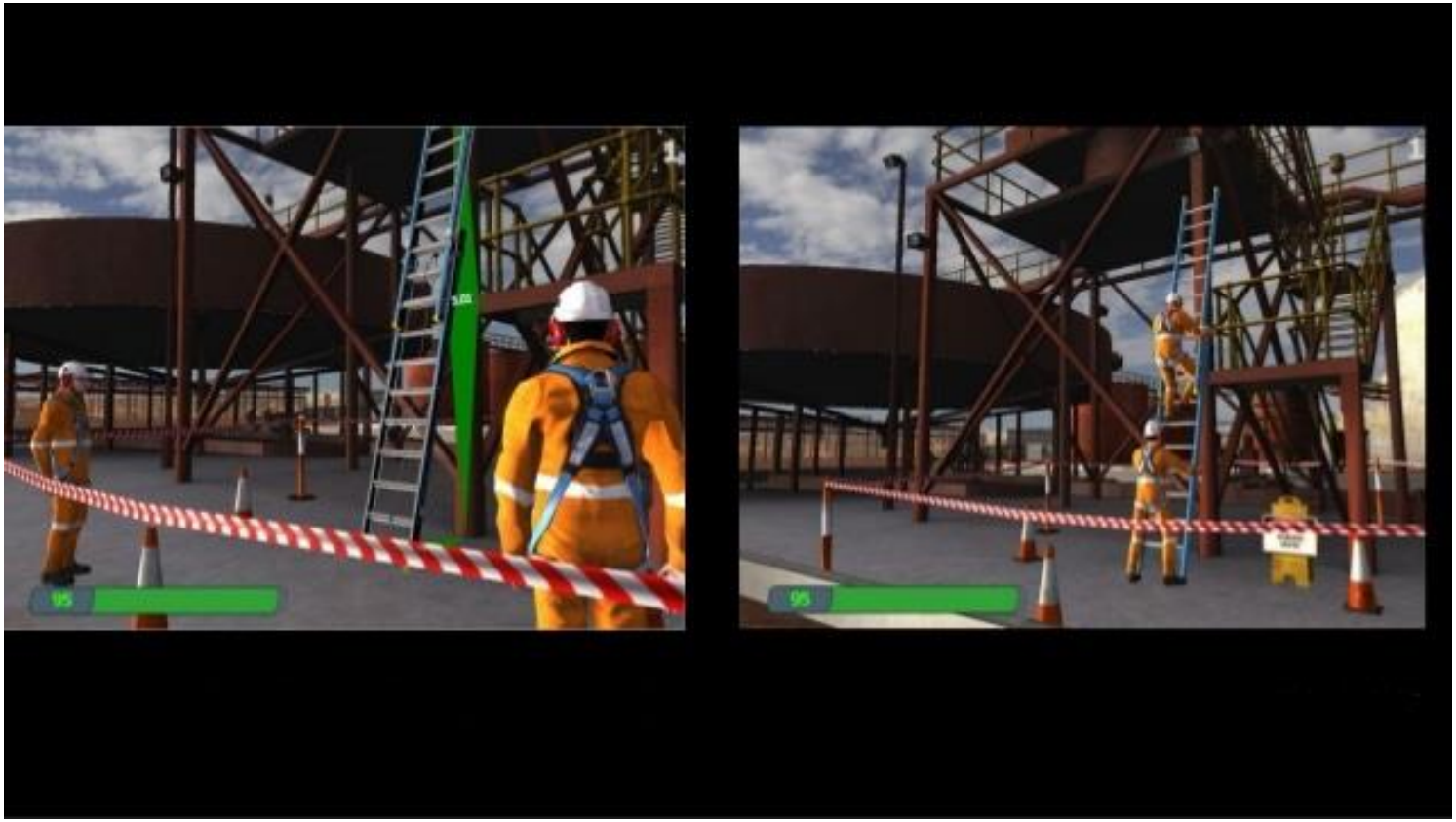
Construction phase

- Prefabrication



Construction phase

- Safety management



Construction phase

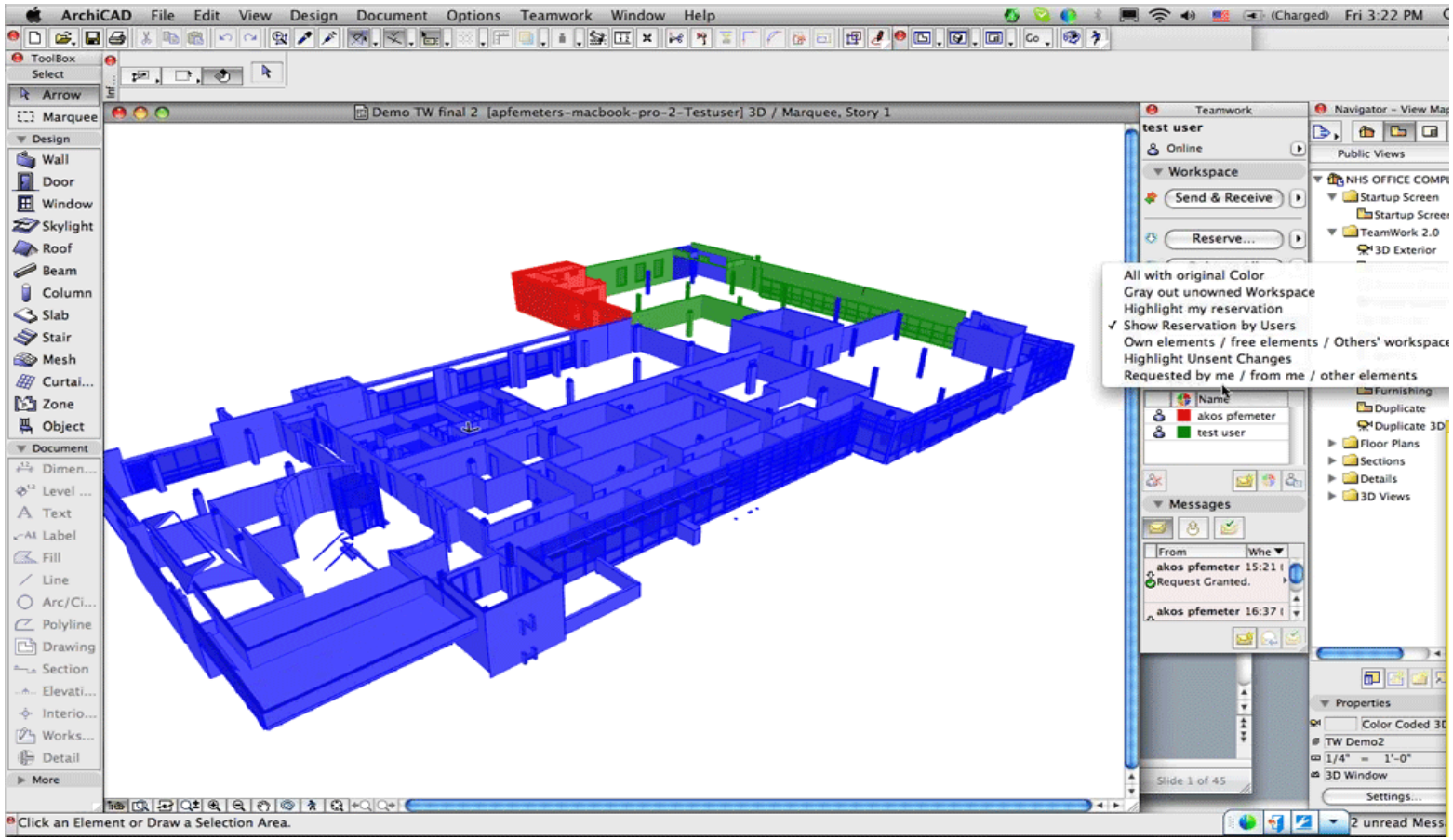
- On-site data access

Construction phase

- Virtual reality and augmented reality in marketing

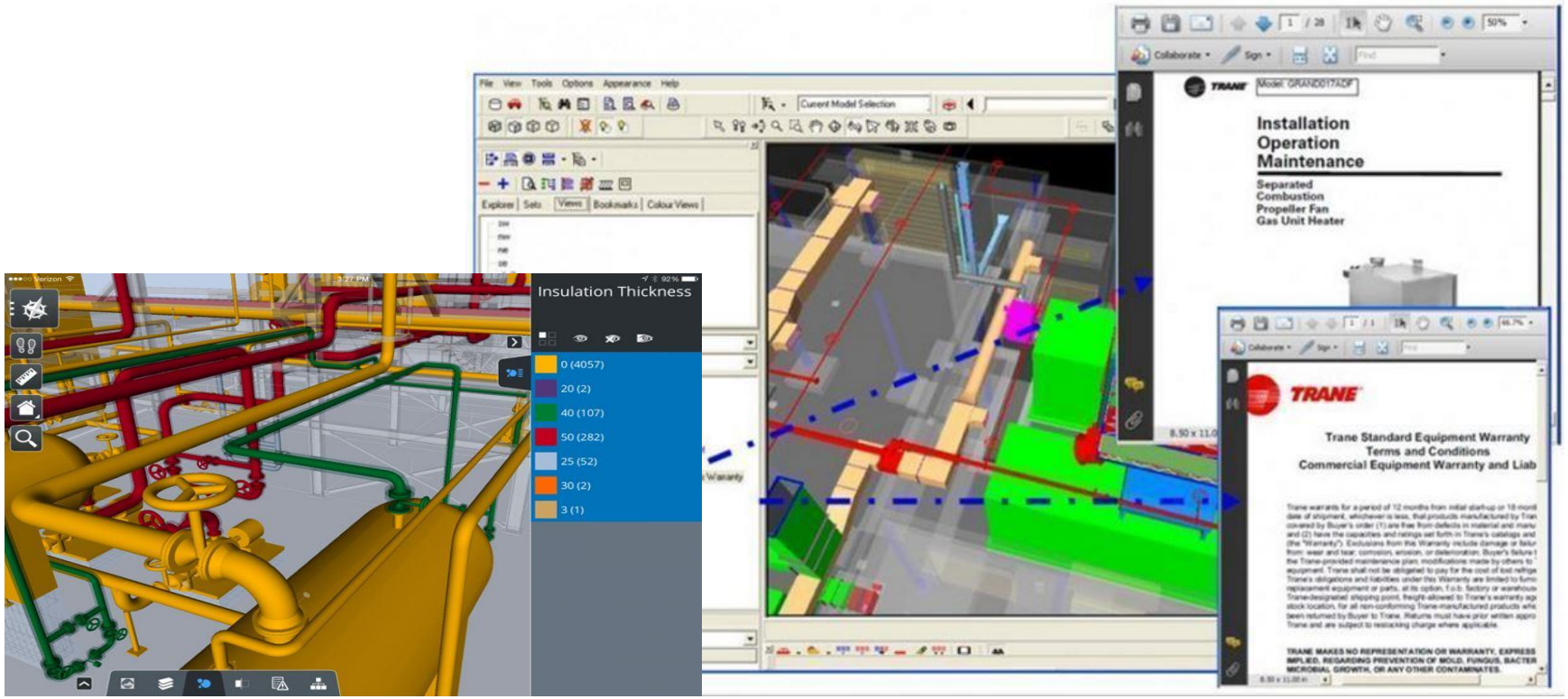
Construction phase

- Project progress control



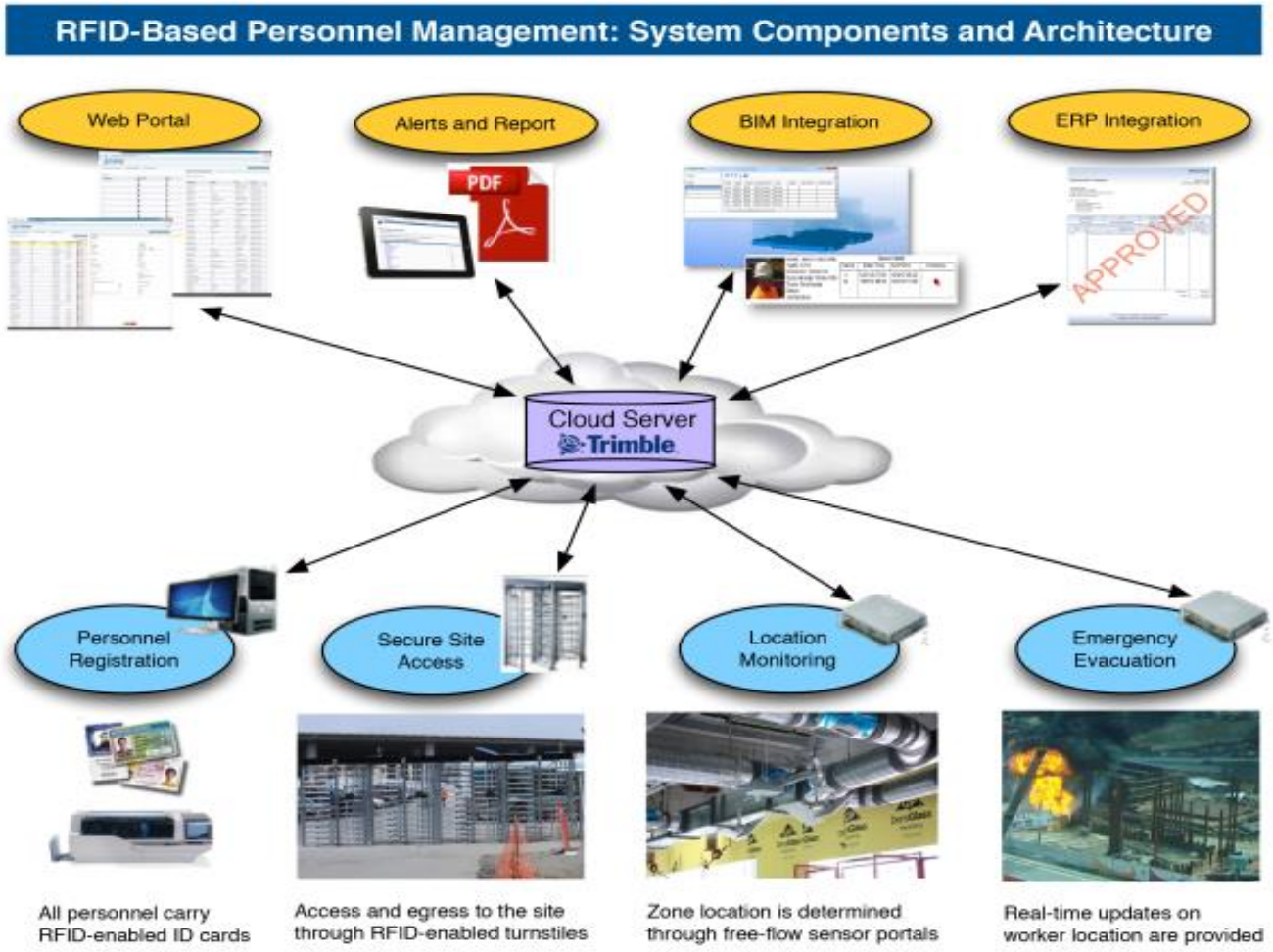
Operation and Maintenance phase

- Facility management



Operation and Maintenance phase

- Emergency planning
- Layout planning



In class practice 1

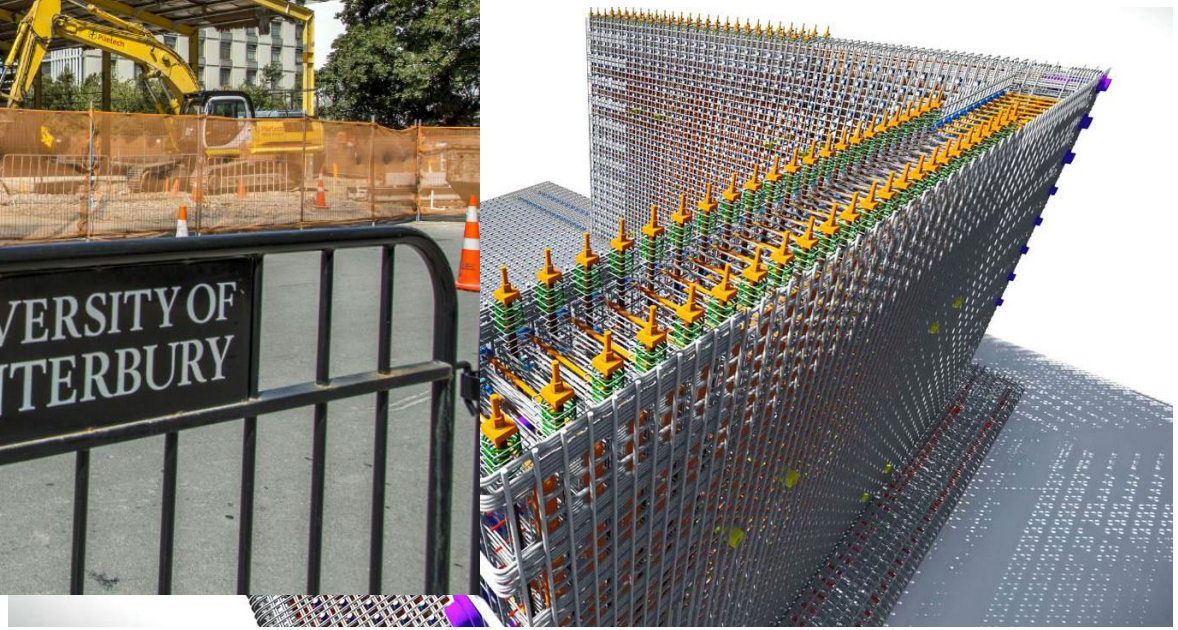
List BIM applications that you recommend for the following projects! What are your justifications for selecting these BIM applications?

- A 10-story residential building
- A 100,000 m2 mall
- A hospital building
- A sport complex

Examples

Example 1: Structural Lab at University of Canterbury

- Construction of the Canterbury University Construction Facility in New Zealand is an example of the implementation of the BIM at the construction stage.



Example 1: Structural Lab at University of Canterbury

- Use of BIM made the project run without any rework and with minimal waste of resources.
- The project has been completed according to the schedule.
- Use of BIM saved at least twice the BIM implementation cost.

Example 2: Northumbria University, UK

- 120,000 square meters of university buildings was transferred to the BIM to more efficiently maintain, operate and develop the buildings in the future.

Example 3: National Taiwan University

- In the construction project of the Faculty of Civil Engineering at Taiwan National University, BIM was used to improve the productivity and selection of suitable materials.

Example 4: Maine General Medical Center

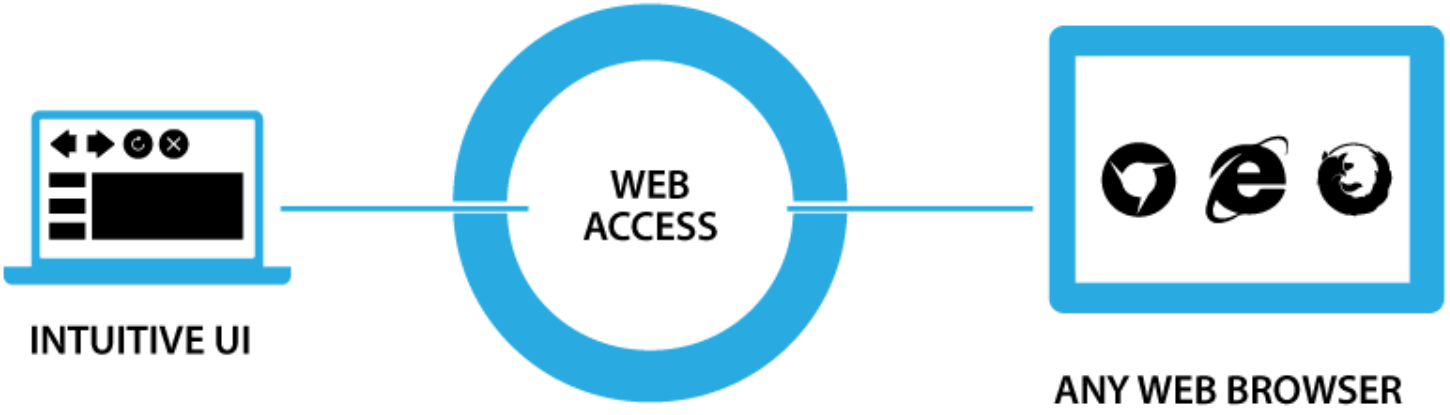
- Maine General Medical Center has 60000 square meter and 192 inpatient beds in Georgia, USA.

Example 4: Maine General Medical Center

- Considering the high cost of the hospital maintenance and the expected cost saving by using, an integrated BIM-based maintenance system was implemented.

Example 4: Maine General Medical Center

- An Internet-based BIM system was implemented where different stakeholders in the hospital could easily access facility information.



Example 4: Maine General Medical Center

- This project led to an annual facility management cost reduction of $185,000 to $225,000.

Example 5: Stanford University Neuroscience Health Center

- This center is located in California, USA, with an area of 8500 square meters.

Example 5: Stanford University Neuroscience Health Center

- Some benefits of the BIM implementation in this hospital can be listed as:
  - Reduced facility maintenance and management cost by 5%
  - 60-70% reduction in repair time due to the facilitated locating of the facilities and equipment

BIM Implementation Challenges

Successful/ Unsuccessful BIM Implementation

(Baldwin, 2019)

- Many BIM projects do not bring the promised benefits, leaving project teams frustrated and behind schedule.
- It is seen especially the case with many BIM implementations in Iran!

So, What does differentiate successful projects from unsuccessful ones?

- *The short answer is strategic planning!!!*

Successful/ Unsuccessful BIM Implementation

(Baldwin, 2019)

- Many factors have a bearing on the success of a BIM project:
  - Project Complexity
  - Scope defined for the project
  - Design changes over the course of the project
  - Project cost
  - Project schedule
  - Technological constraints
  - Team competency and experience.
- 1) Setting realistic goals, 2) managing expectations across the team, and 3) planning and executing projects in a structured manner, are the components of successful BIM project implementation.

BIM Implementation Complexity

(Baldwin, 2019)

- ***BIM*** is a main tool for improving ***management*** of the construction projects!
- Successful implementation of ***BIM*** projects requires a proper knowledge from various conceptual and technological aspects of ***BIM.***
- Many of these conceptual and technological BIM aspects get quite complex, specially when they are dealt with in the context of specific types of construction projects with a set of unique project organizational and technical issues!

How many knowledgeable individuals in both conceptual and technological aspects of BIM do you know in our BIM implementation projects?

BIM Implementation Complexity

(Baldwin, 2019)

- ***Project Management*** bears a broad fields of knowledge and expertise
- Successful BIM implementation requires a robust project management knowledge and experience.

How many proficient project managers do you know?

- *Therefore, BIM implementation is a complex endeavor to take! It requires deep knowledge of the implementation team in both BIM and Project management!*

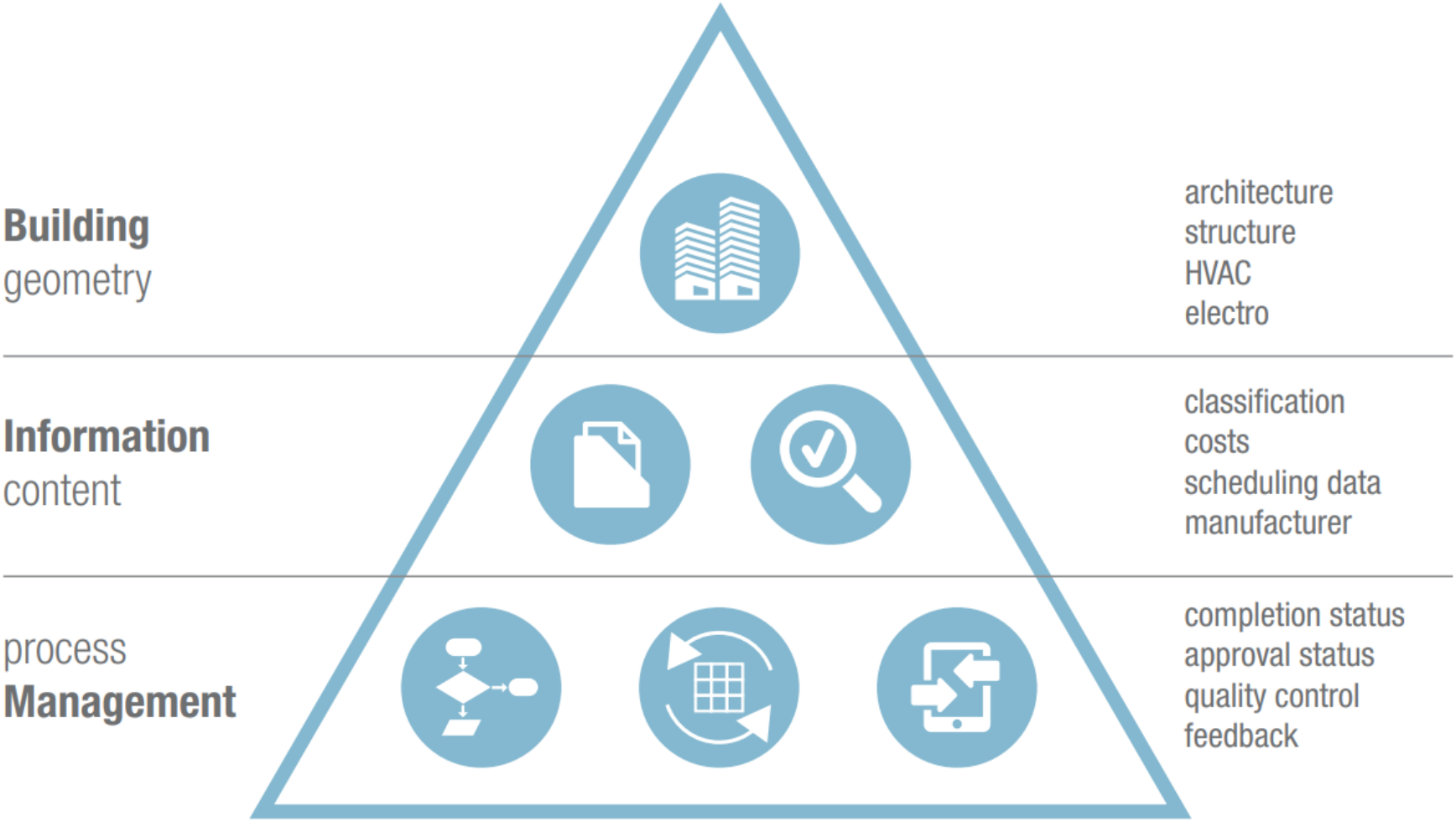
BIM Implementation Pyramid

(Baldwin, 2019)

- BIM implementation is not a definite notion!
- When we talk about BIM implementation, a wide range of implementation levels comes in mind!
- This implementation range can be represented as the BIM pyramid!

BIM Implementation Pyramid

(Baldwin, 2019)



The BIM Pyramid (Baldwin, 2019)

BIM Implementation Pyramid-Geometry

(Baldwin, 2019)

- The first specification of a BIM model which comes to mind is the *3D geometric* formation of the BIM models. Geometry is the first tier of BIM implementation!
- Building geometry stays at the top of the BIM implementation Pyramid, Why? 
- A part of expected benefits of BIM implementation is achievable via the sole use of 3D geometric specifications of BIM models!
- Even proper use of 3D geometric capability of BIM models alone can bring great benefits to the construction projects!
- Some example benefits are: better space design, merging different design disciplines, communicating with non-professionals, and locating covered items.

BIM Implementation Pyramid-Geometry

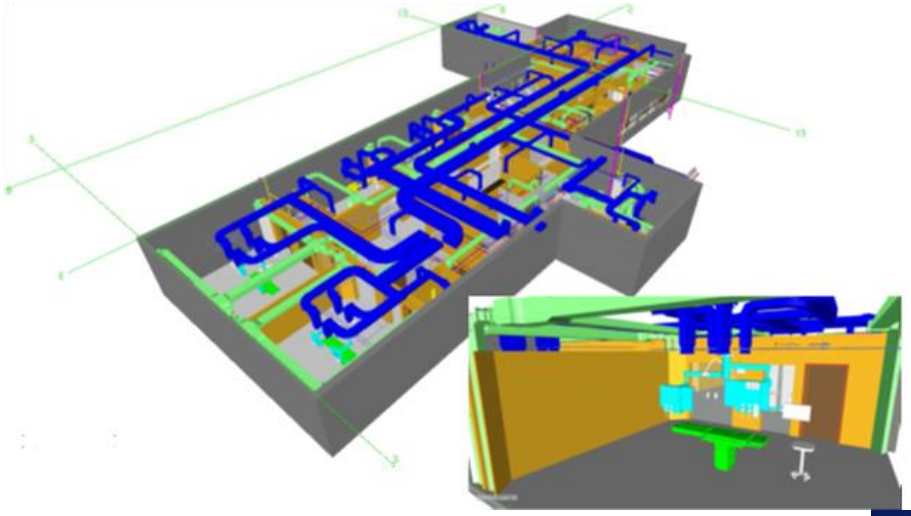
Experimental Case:

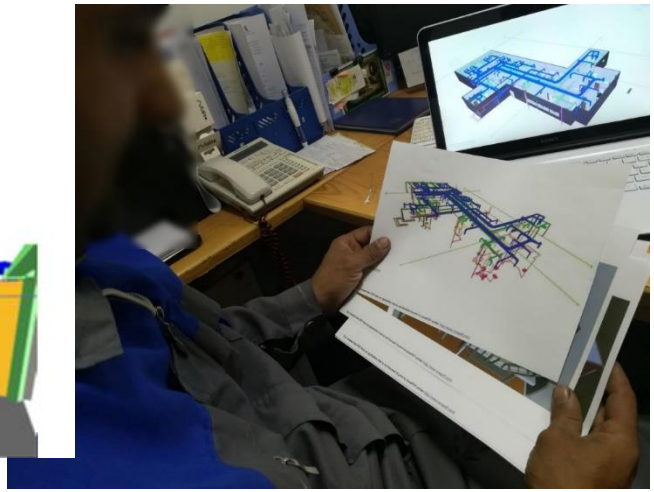
- Hospitals buildings have a complicated set of utility systems
- Their maintenance requires high amount of money and effort
- We shadowed the maintenance and repair operations in one public hospital in Tehran.
- Major issues identified were:
  - Difficulty to read and merge 2D drawings
  - Problem to find location of components
  - Lengthy training period for new crews

BIM Implementation Pyramid-Geometry

Experimental Case:

- We identified BIM as a proper tool to facilitate the hospital buildings' maintenance management
- Simple use of 3D models could help the maintenance crew to merge models of different disciplines, to locate the covered components and train new maintenance crew





BIM Implementation Pyramid-Geometry

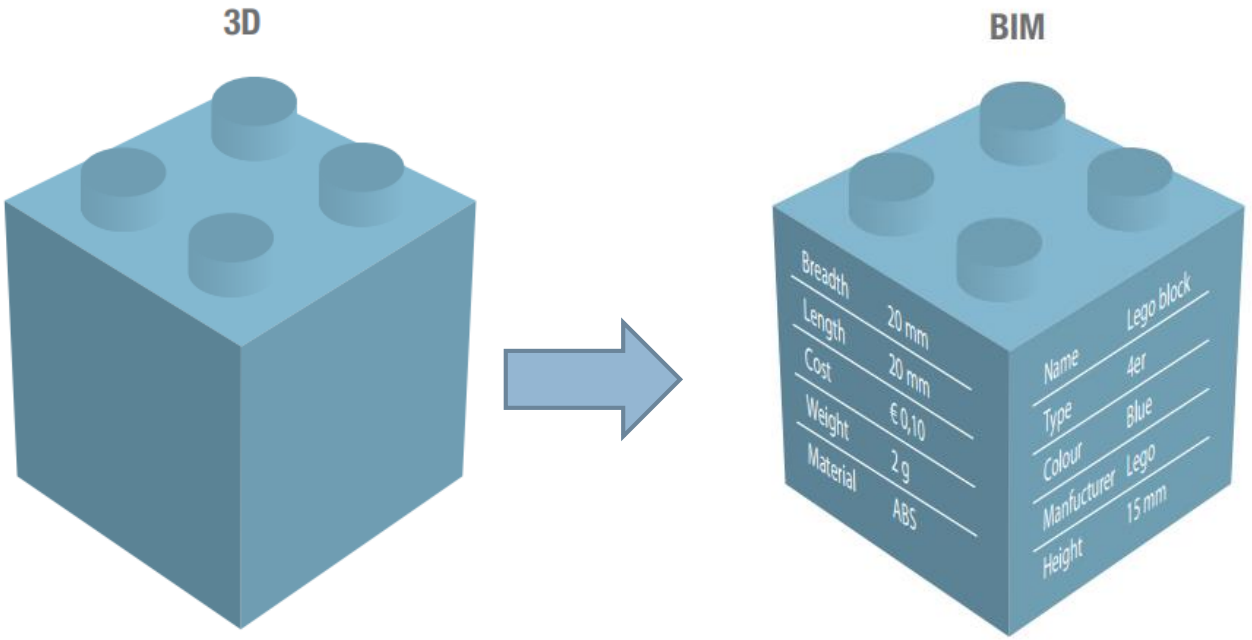
(Baldwin, 2019)

- In the broader context, however, 3D geometric specification of the BIM models is only a fraction of what BIM represents.
- Although the benefits of a geometric model are great!!!, they are overshadowed by the value of the information content for improving performance of the construction projects.

BIM Implementation Pyramid-Information

(Baldwin, 2019)

- It is the *data* embedded in the model that represent its true worth.



- Object data, or properties, are the basis for *search criteria*, *simulation,* and *analysis*. Information content is the second tier of BIM implementation.

BIM Implementation Pyramid-Information

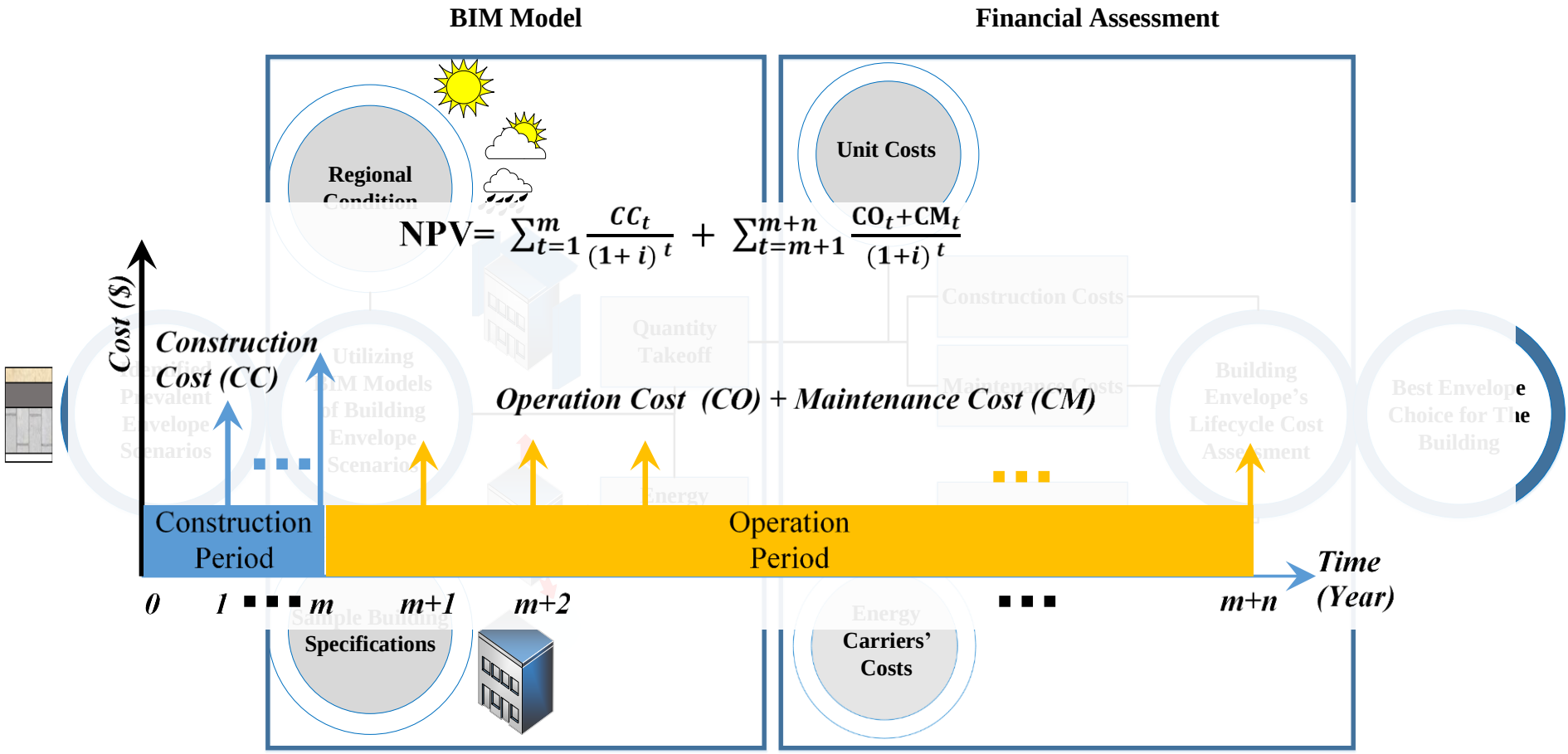
Experimental Case:

- We used BIM as a powerful tool for improving lifecycle cost and energy performance of buildings.
- The focus of this study was on finding the most appropriate building envelope structures considering specific regional condition.
- Regional conditions: weather condition, availability of materials in the region, material purchase, transportation and installation cost!
- BIM models were utilized for the material quantity takeoff and energy simulation of the building.

BIM Implementation Pyramid-Information

Experimental Case:

Proposed BIM based framework for improving lifecycle cost of buildings



BIM Implementation Pyramid-Information

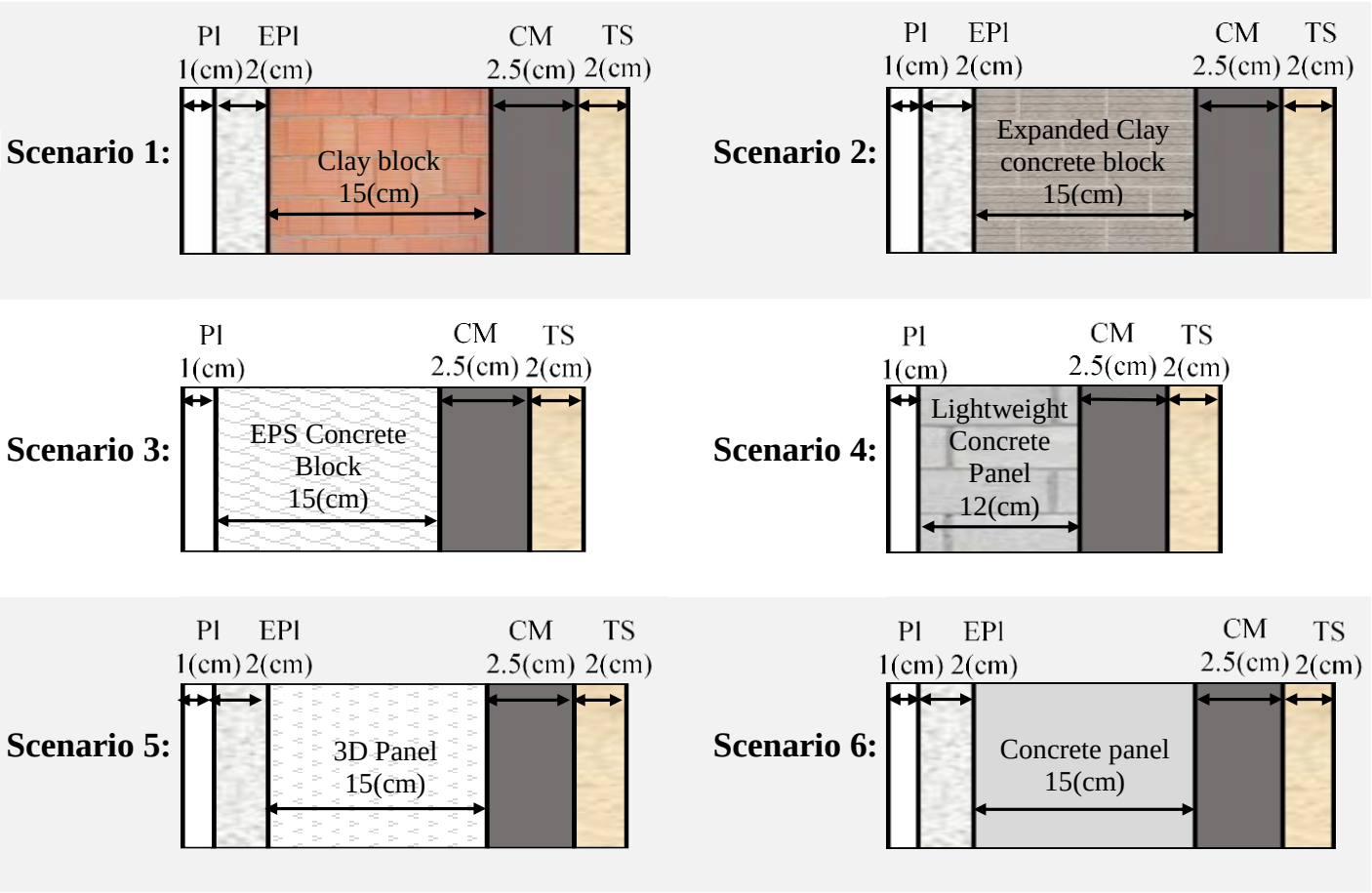
Experimental Case:

- The BIM based framework was implemented in a residential building in Tehran, Iran.

- Prevalent building envelope structures were identified and compared:

BIM Implementation Pyramid-Information

Experimental Case:



Pl: Plaster; EPl: Earth Plaster; CM: Cement Mortar; TS: Travertine Stone; Sh: Shotcrete; EP: Expanded Polystyrene.

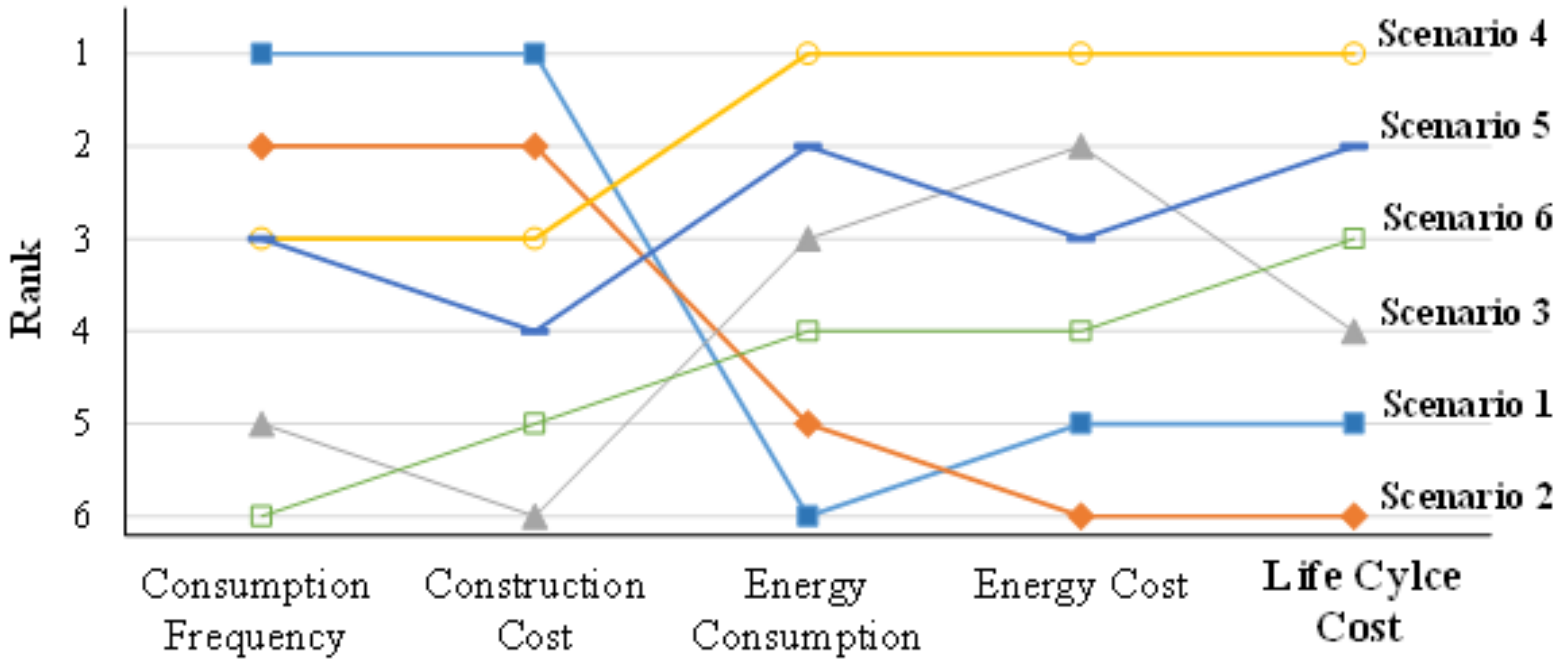
BIM Implementation Pyramid-Information

Experimental Case:

- In addition to the geometry, BIM model of the building was used for extracting various other information items required for the assessment, including:
  - Material type
  - Material density
  - Thermal conductivity of materials
  - Structure of different envelope components including wall, window and roof
  - Surface area to the outside condition

BIM Implementation Pyramid-Information

Experimental Case:



BIM Implementation Pyramid-Management

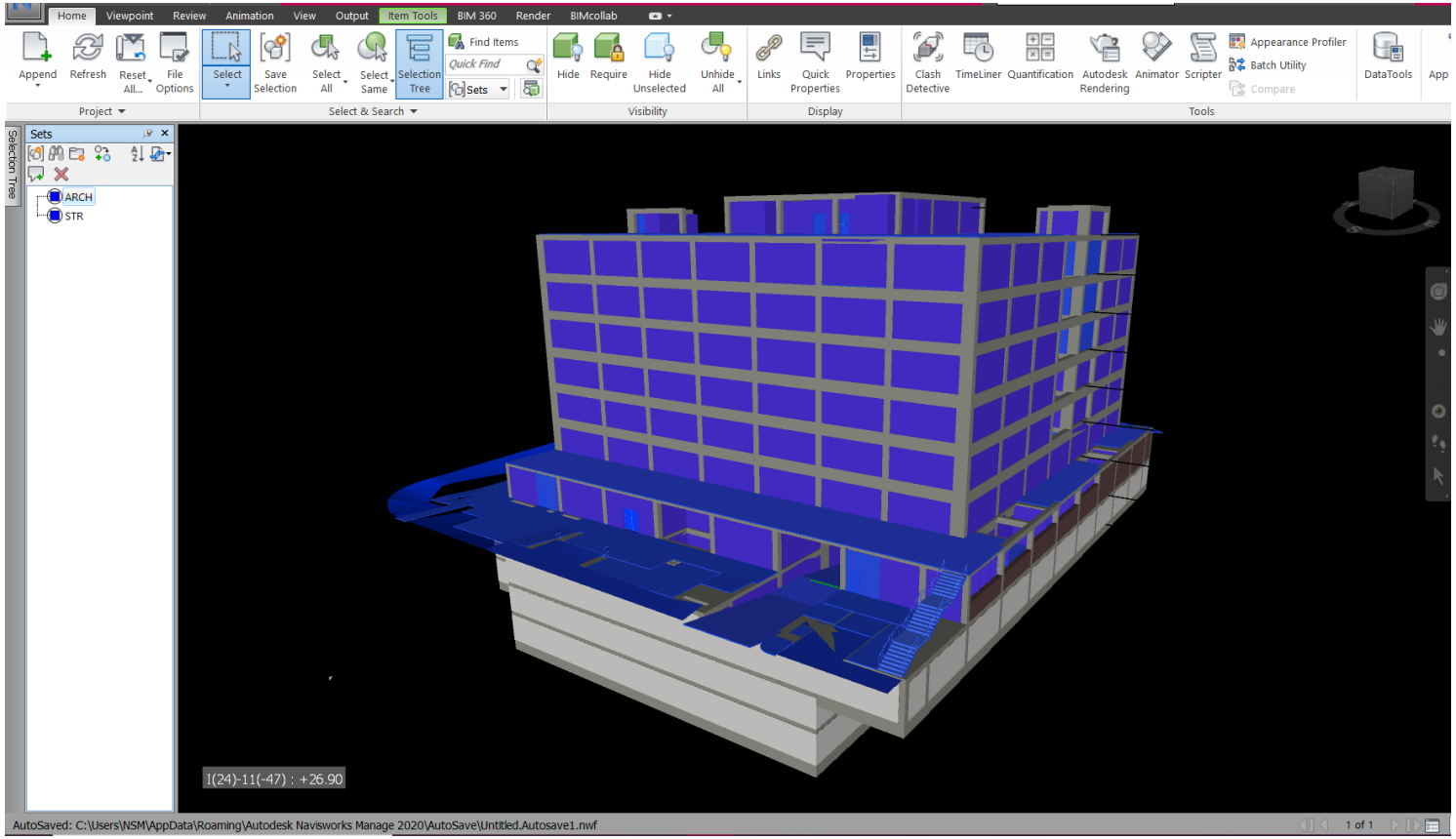
(Baldwin, 2019)

- BIM implementation reaches its highest impact when it is incorporated into the project management processes.
- Process Management refers to all the organizational issues around process definition, plan and control.
- Especially, BIM can effectively facilitate the collaboration and coordination activities required in the project management processes.
- Sample BIM applications in project process management are:
  - Defining model content and delivery requirements;
  - Establishing digital workflows;
  - Managing design processes;
  - Managing changes;
  - Controlling quality

BIM Implementation Pyramid-Management

Experimental Case:

- BIM based design clash detection and removal in a hospital project



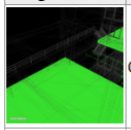
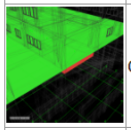
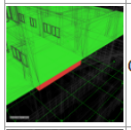
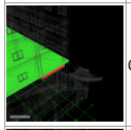
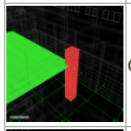
BIM Implementation Pyramid-Management

Experimental Case:

AUTODESK® NAVISWORKS®

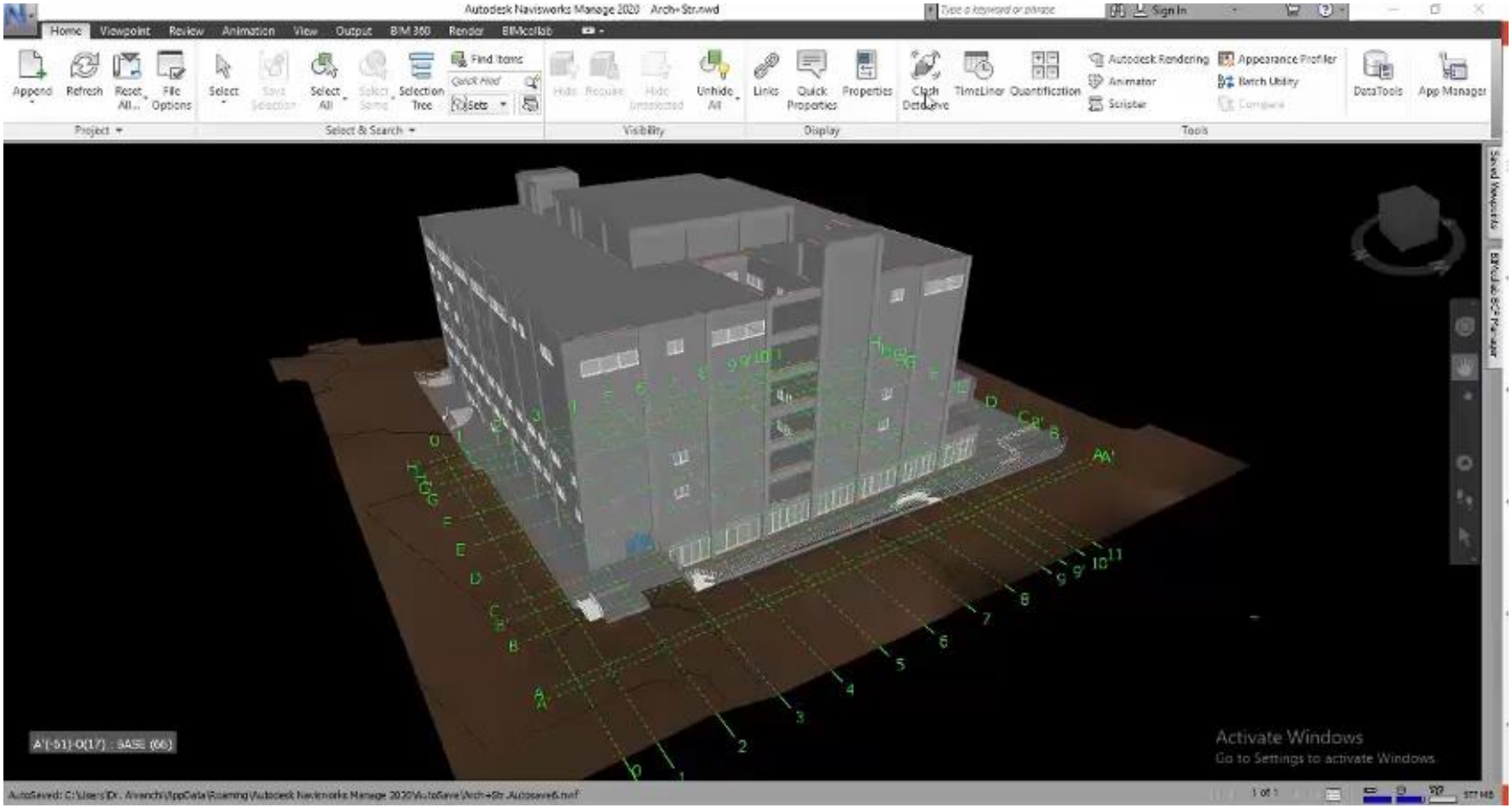
Clash Report

Test 1	Tolerance	Clashes	New	Active	Reviewed	Approved	Resolved	Type	Status
	0.001m	108	108	0	0	0	0	Hard	OK

								Item 1				Item 2			
Image	Clash Name	Status	Distance	Grid Location	Description	Date Found	Clash Point	Item ID	Layer	Item Name	Item Type	Item ID	Layer	Item Name	Item Type
	Clash1	New	-0.400	A-5 : BASE	Hard	2019/9/30 18:26	x:127.543, y:39.150, z:5.000	*Element ID*: 394851	1 ST	C30	Solid	*Element ID*: 237218	Level 1	Concrete, Broom Finish	Solid
	Clash2	New	-0.400	H-4 : BASE	Hard	2019/9/30 18:26	x:181.043, y:47.812, z:5.000	*Element ID*: 394905	1 ST	C30	Solid	*Element ID*: 237218	Level 1	Concrete, Broom Finish	Solid
	Clash3	New	-0.400	H-4 : BASE	Hard	2019/9/30 18:26	x:181.043, y:44.186, z:5.000	*Element ID*: 394902	1 ST	C30	Solid	*Element ID*: 237218	Level 1	Concrete, Broom Finish	Solid
	Clash4	New	-0.352	H-1 : BASE	Hard	2019/9/30 18:26	x:181.743, y:67.600, z:5.000	*Element ID*: 394911	1 ST	C30	Solid	*Element ID*: 237218	Level 1	Concrete, Broom Finish	Solid
	Clash5	New	-0.341	E-3 : BASE	Hard	2019/9/30 18:26	x:158.293, y:53.600, z:8.452	*Element ID*: 392598	1 ST	C30	Solid	*Element ID*: 408469	Level 1	Default	Solid
															

BIM Implementation Pyramid-Management

Experimental Case:



BIM Elephant

(Baldwin, 2019)

- In recent years, BIM applications have rapidly penetrated in different aspects of construction projects.
- BIM is applied to all disciplines across the planning and organization, design, construction, and operation phases of a building.
- Depending on the project specification, each instance of BIM application can take on a new form.
- The rapid growth and broad applications of BIM have created confusion and ongoing debates about the terminology and principles that define BIM.
- Similar BIM terminology and principles mean different things to different people.

BIM Elephant

The BIM Elephant (Baldwin, 2019)

Home assignment 4-BIM applications

Name 5 different BIM applications in the construction project lifecycle, other than the BIM applications discussed in this lecture.

1) Identify the project phase that each BIM application is used,
2) Briefly explain the way that each BIM application works,
3) Briefly explain how each BIM application can benefit construction projects,
4) Identify level of complexity of each BIM application in the BIM Pyramid!
5) Discuss the arrangements required for successful implementation of each application!

(One week)

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Thank you!

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