SBM5101/SBS5322 BIM Technology

http://ibse.hk/SBM5101/ | http://ibse.hk/SBS5322/

Background

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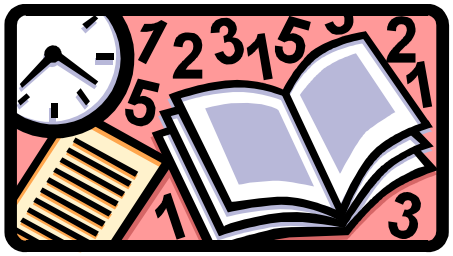
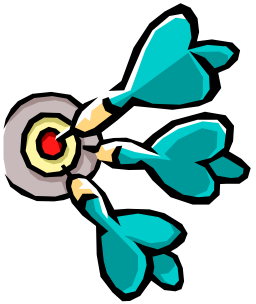
May 2019

Background



- Module Aim(s):
  - This module introduces the basic concepts and essential background of building information modelling (BIM) to students of building services engineering and other related professional disciplines. It extends the knowledge in engineering drawing and computer-aided design (CAD) in construction projects, and develop skills necessary for understanding virtual design and construction (VDC). Students will learn the conceptual background of BIM and apply the principles for the various aspects of BIM.



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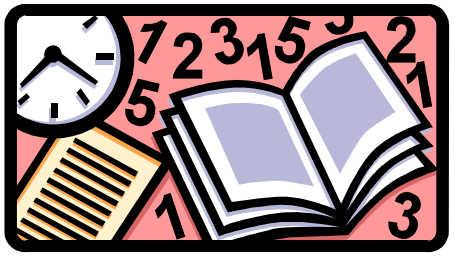
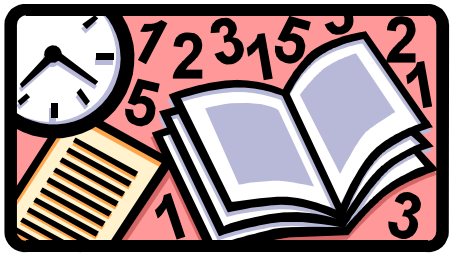
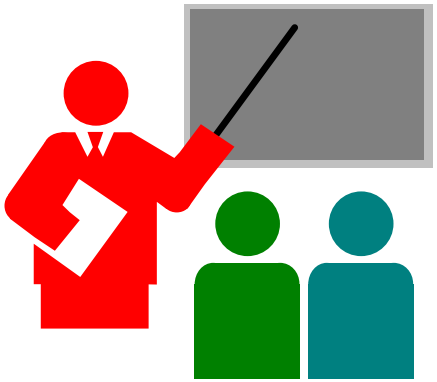


- Learning Outcomes:
  - 1. explain the basic concepts of BIM for construction and building projects;
  - 2. identify the various aspects of BIM and evaluate their potential benefits for different building professionals and stakeholders; and
  - 3. apply the fundamental techniques of BIM to CAD applications and automated construction solutions.

Background



- Lecturers:
  - Ir Dr. Sam C. M. Hui (cmhui@vtc.edu.hk)
  - Ir Dr. NG Tsz Ho Roger (rogerng@vtc.edu.hk)
- Course Website: (with links and resources)
  - http://ibse.hk/SBM5101/
  - http://ibse.hk/SBS5322/
- Moodle system
  - http://moodle.vtc.edu.hk/
- Your previous learning forms a basis:
  - Engineering Drawing and Construction CAD



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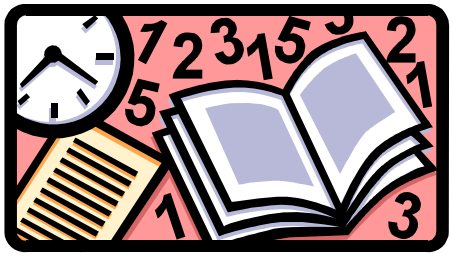

- Assessment Components:
- Assignments (50%)
  - Assignment by Dr. Hui (30%)
  - Assignment by Dr. Ng (20%)
- Examination (50%) (3 hours)
  - Section A by Dr. Hui (6 out of 7 questions @ 10 marks)
  - Section B by Dr. Ng (4 out of 5 questions @ 10 marks)

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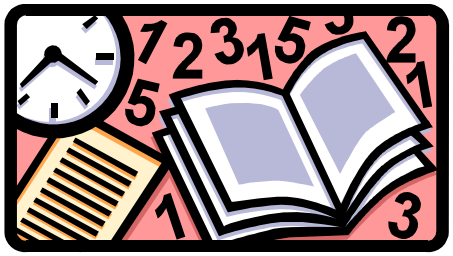


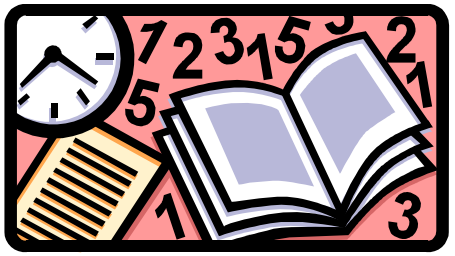
- Study topics:
  - 1. Introduction to BIM
  - 2. Computer modelling and BIM software
  - 3. BIM uses and processes: BIM workflow & strategy
  - 4. BIM uses and processes: Pre-tender requirements
  - 5. BIM uses and processes: Definition & design stage
  - 6. BIM uses and processes: Construction stage
  - 7. BIM uses and processes: Handover + O&M stages
  - 8. BIM uses and processes: Practical examples

Dr. Hui

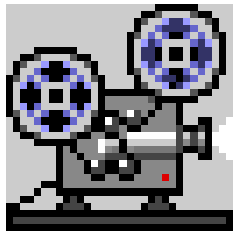
  - 9. Digital information management
  - 10. Common data environment
  - 11. Data quality control & assurance
  - 12. Commercial and contract issues (2 weeks)

Dr. Ng

Background



- Learning Methods:
  - Lectures + Further Reading
  - Individual Assignments
  - Discussions
    - During lectures/tutorials
  - Guest lectures
- Resources:
  - Video presentations
  - Web links + References



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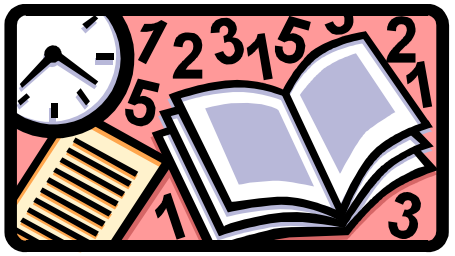

- Useful references:
  - Arayici, Y., 2015. *Building Information Modeling*, bookboon.com (The ebook company). https://www.academia.edu/32112187/Building_information_modeling
  - Barnes, P. and Davies, N., 2015. *BIM in Principle and in Practice*, Second edition, ICE Publishing, London.
  - Kumar, B., 2015. *A Practical Guide to Adopting BIM in Construction Projects*, Whittles, Dunbeath.
  - Denis, F., 2015. *Building Information Modelling – Belgian Guide for the Construction Industry*, ADEB-VBA, Brussel. (http://adeb-vba.be/the-guide-to-bim.pdf)

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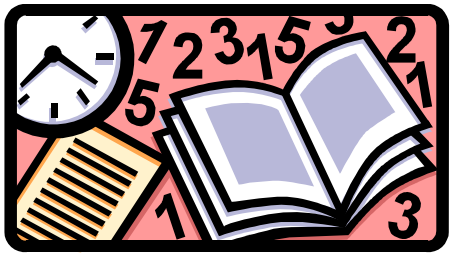

- Useful Websites:
  - Autodesk BIM Curriculum http://bimcurriculum.autodesk.com/
  - Autodesk Design Academy http://academy.autodesk.com
  - BIM - Construction Industry Council http://www.bim.cic.hk
  - BIM@Singapore http://bimsg.org/
  - BIM Basics [BIM+]
    - http://www.bimplus.co.uk/bim-basics/
  - BIM For Beginners [theb1m.com]
    - http://www.theb1m.com/BIM-For-Beginners
  - Graphisoft BIM Curriculum
    - http://www.graphisoft.com/learning/bim-curriculum/

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Introduction to BIM

Ir. Dr. Sam C. M. Hui
Faculty of Science and Technology
E-mail: cmhui@vtc.edu.hk

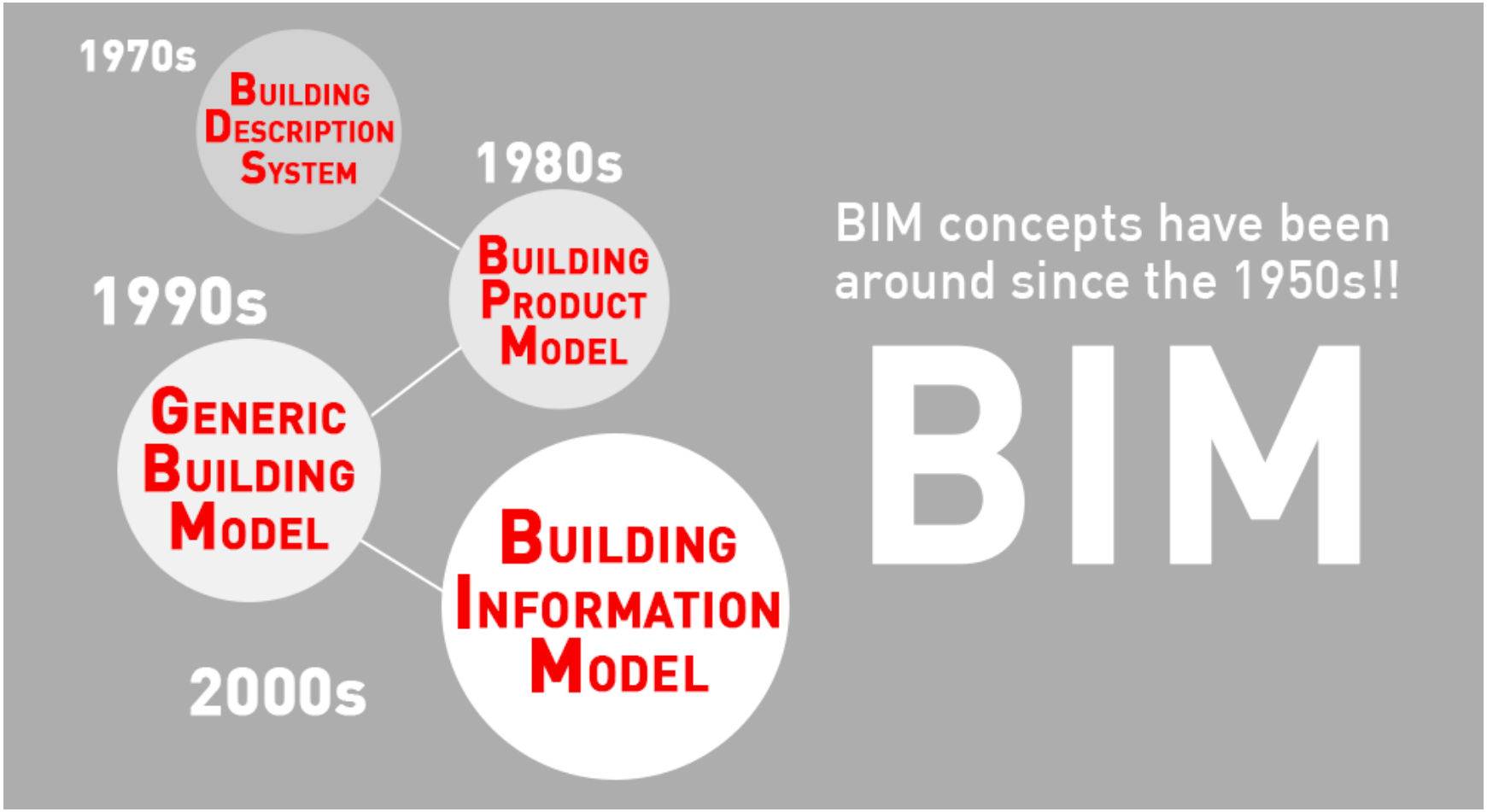
May 2019

Contents

- History: From 2D to BIM
- Drawing skills and BIM
- Basic concepts of BIM
- Why BIM?
- BIM elements and standards
- BIM dimensions

History: From 2D to BIM

- BIM concept has existed since the late-50s



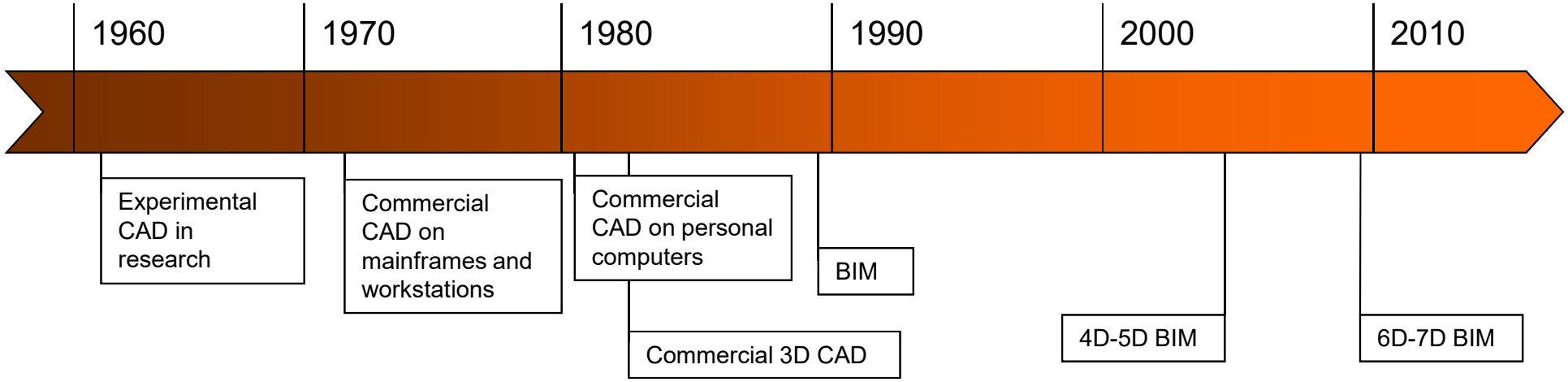
(Source: If BIM's a Mystery, Here's the History! https://www.exactal.com/en/company/blog/if-bims-a-mystery-heres-the-history/)

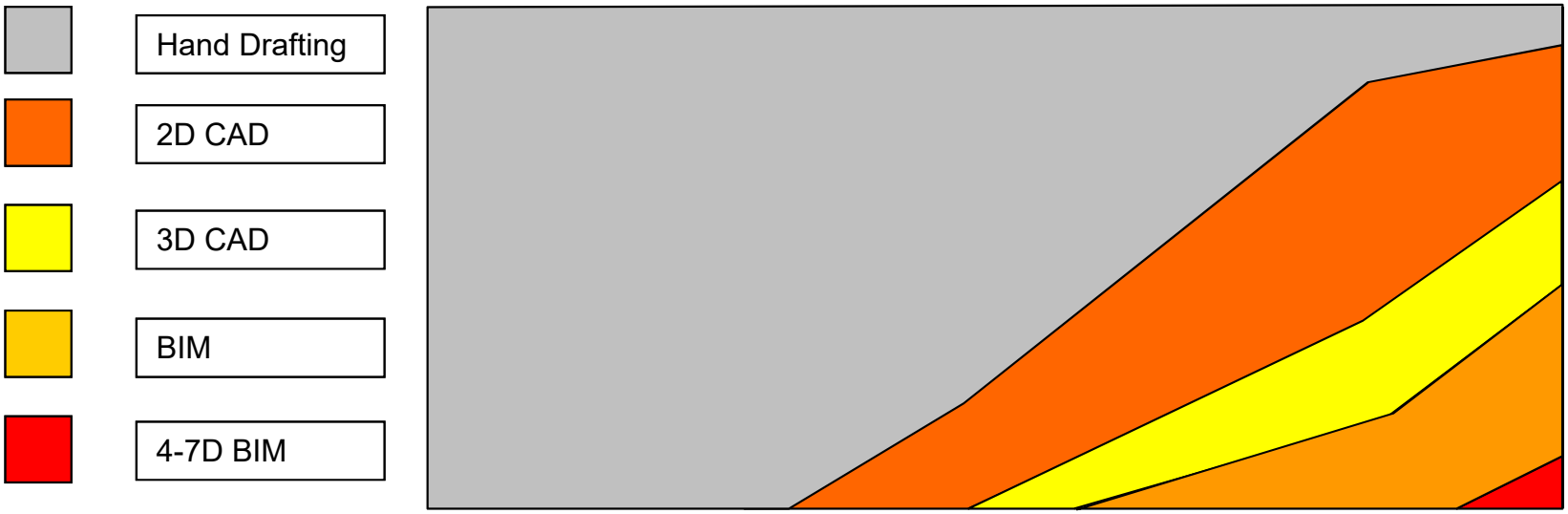
Evolution of AEC CAD

- 2D solutions
  - Electronic drafting board
- 3D solutions
  - Modeling for pure visualization purposes
- BIM solutions
  - Models with integrated architectural information
- 4D-5D BIM - Construction Coordination
  - Timing/scheduling and Cost estimation
- 6D-7D BIM
  - Facility Management and Life Cycle Management

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

AEC CAD Timeline





(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

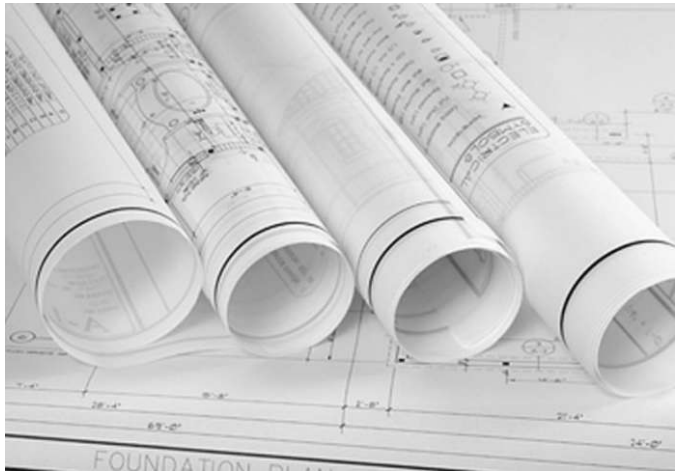
2D CAD - Workflow

- Design and document all in 2D
- No 3D model
- Drawings in separate files
- Manual coordination of drawings
- No visualization and calculation tools

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

2D CAD - Evaluation

Benefits



Compared to hand drafting

- Fast modifications
- Accuracy
- Intelligent drafting tools (fills, dimensions)
- Repetitive element handling (blocks, xrefs)

Compared to 3D CAD and BIM

- Simple working concept (electronic drafting)
- Relatively small file size (only 2D data)
- Workflow is applicable for all building types

Drawbacks

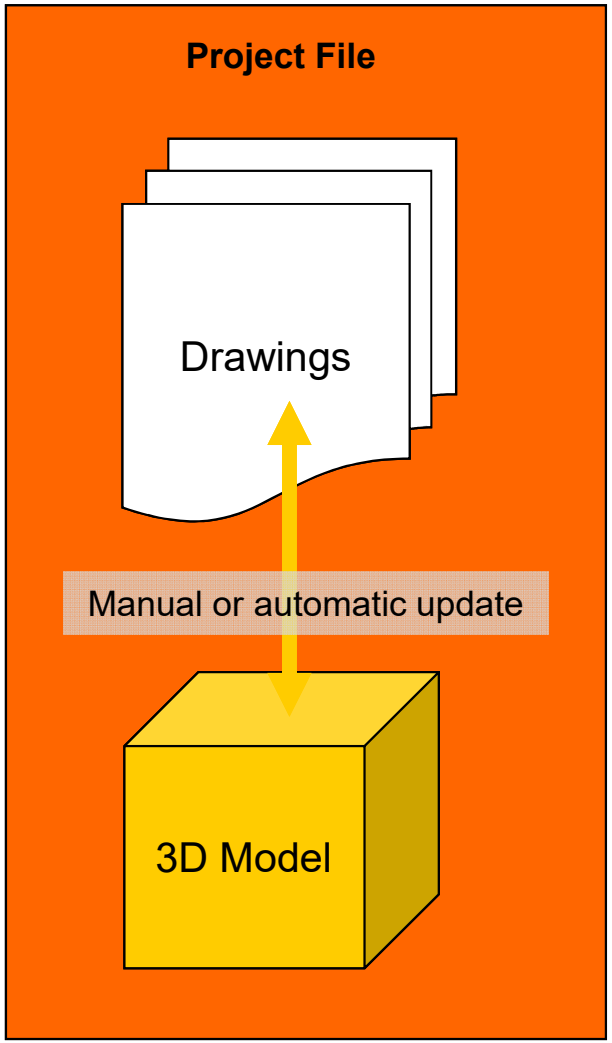
Compared to 3D CAD and BIM

- Drawings are not coordinated automatically
- No 3D visualization
- No automatic calculations, quantity take-offs or schedules
- No collision detection

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

3D CAD - Workflow

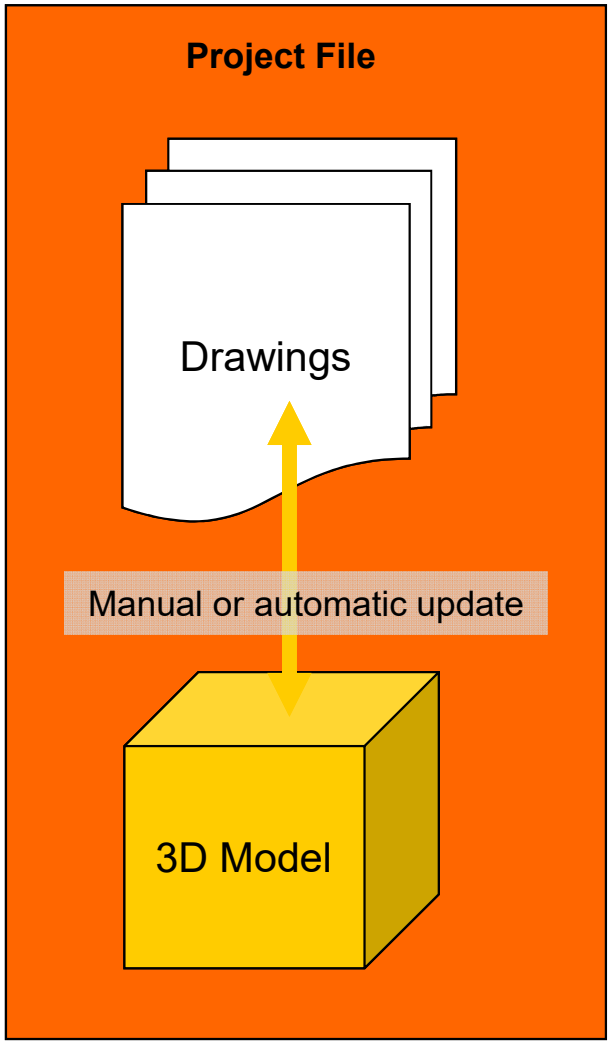
- CAD application has 2D & 3D capabilities
- Buildings can be modeled in 3D
- 3D and 2D information can be included in one file
- Drawings are (partially) derived from the model
- No automatic documentation
- Applications mostly works with 2D and 3D tools instead of real architectural elements
- Basic visualization and calculation tools



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

3D CAD - Evaluation

- **Benefits**
  - Compared to 2D CAD
    - Easier identification of design problems
    - Faster change management
    - Visualization and calculation capabilities
  - Compared to BIM
    - 3D modeling is optional
    - Smaller file size
- **Drawbacks**
  - Concept doesn't follow the architectural design process
  - No automatic documentation
  - No real architectural elements



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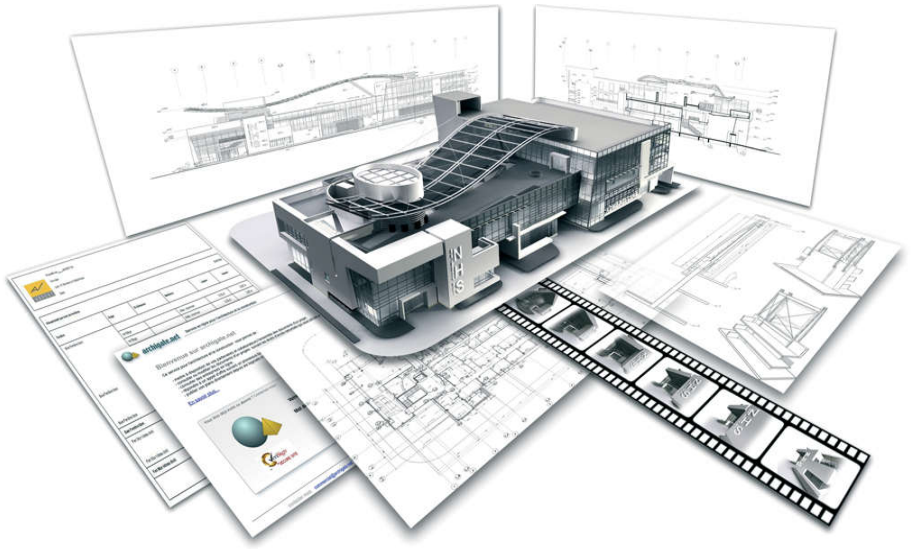
The BIM Concept



NHS Office, www.paastudio.com

BIM = **B**uilding **I**nformation **M**odeling

Also known as „Virtual Building" or „Building Simulation"

Drawings, model views, visualizations, calculations and quantity take-offs are automatically derived from the 3D model.

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

BIM - Workflow

- Single file concept:
- The complete building model and all of it's representations are included in the virtual building file

- Real architectural elements used for modeling

- Changes of the model affects all drawings, and vice versa

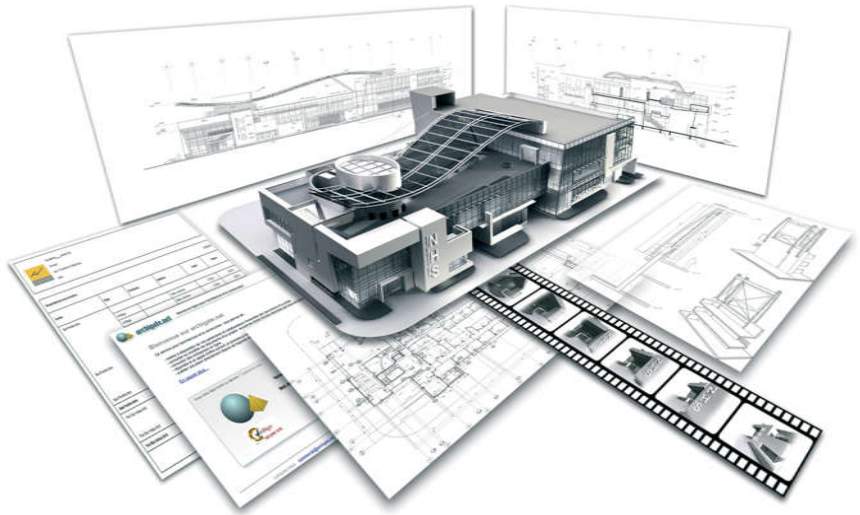
- Automatic documentation workflow

- Rich architectural content (libraries)

- Building information data attached to
- the elements

- Internal visualization tools

- Calculations, schedules



NHS Office, www.paastudio.com

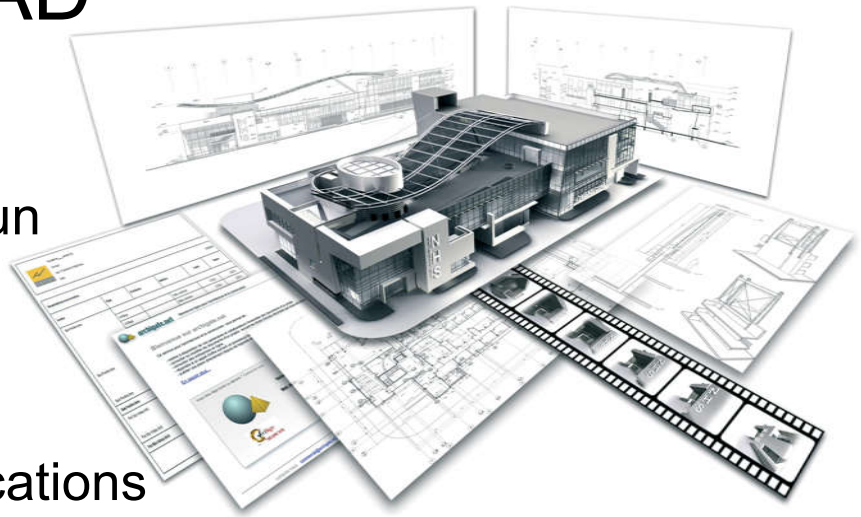
(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

BIM - Evaluation

Benefits

Compared to 2D and 3D CAD

- Real architectural elements
- Automatic drawing coordination
- Rich visualization content (animation, sun studies, renderings etc.)
- Automatic quantity take-offs, schedules
- Connection to structural, MEP, energy calculation and collision detection applications



NHS Office, www.paastudio.com

Drawbacks

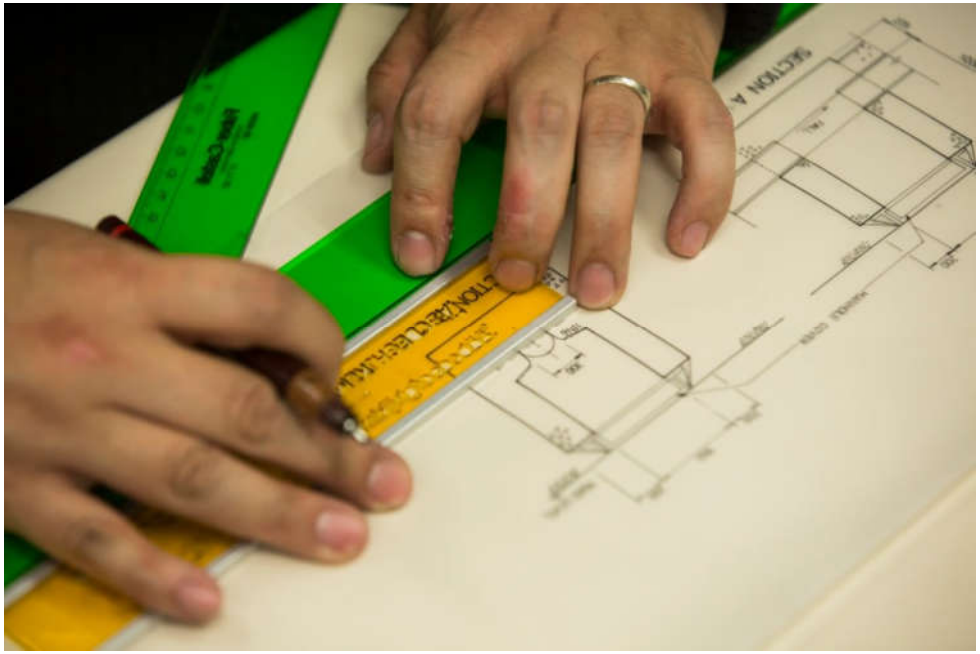
Compared to 2D and 3D CAD

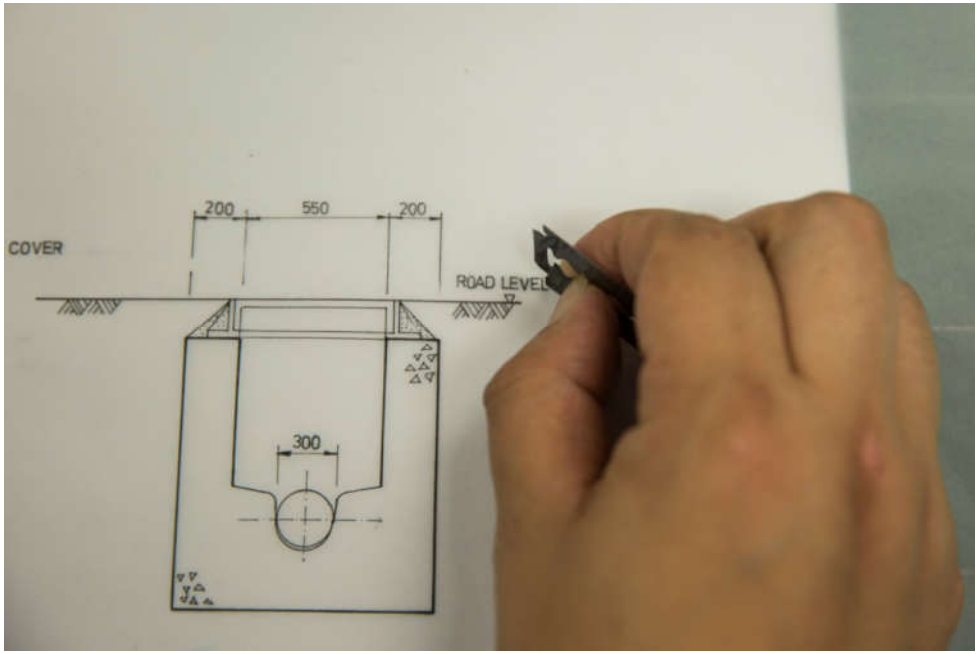
- Might be difficult to learn the BIM approach for 2D cross-graders
- Training requirements

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Drawing skills and BIM

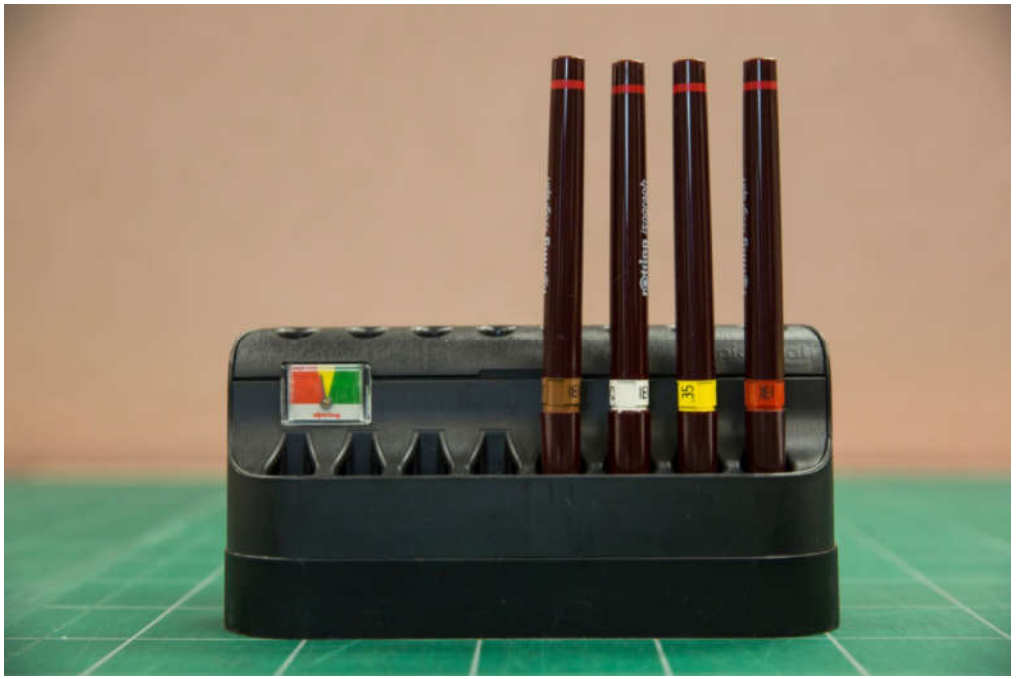
Hand drafting of technical and engineering drawings becomes a history

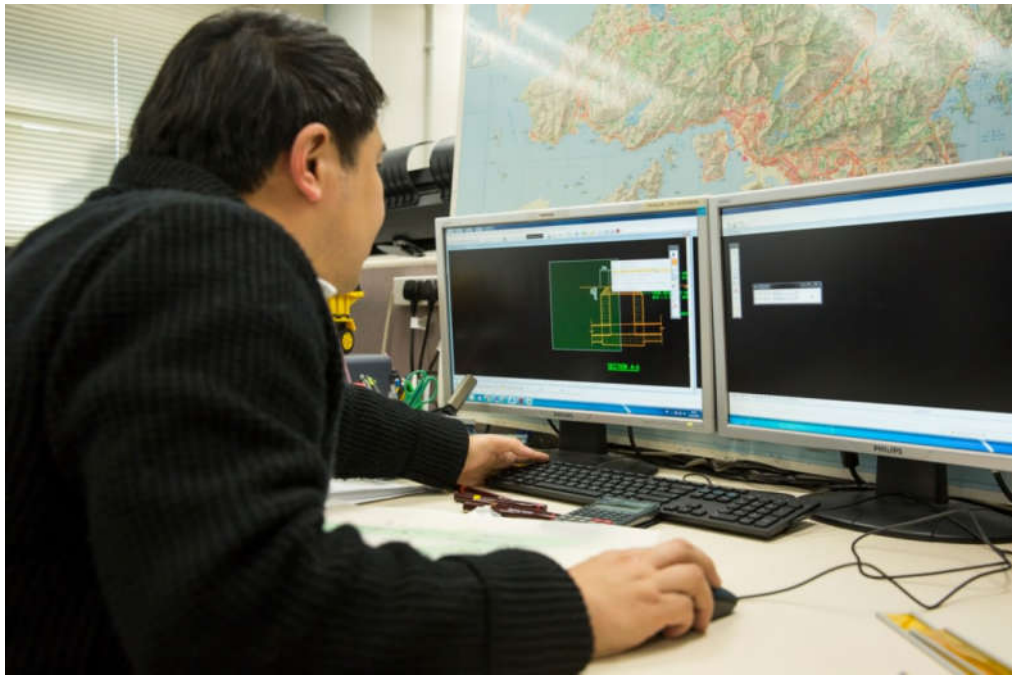




(Source: 一筆一劃勾勒工程靈魂　渠署繪圖師：圖則是將意念實踐 (HK01 News))

Hand drafting tools and computer-aided drafting





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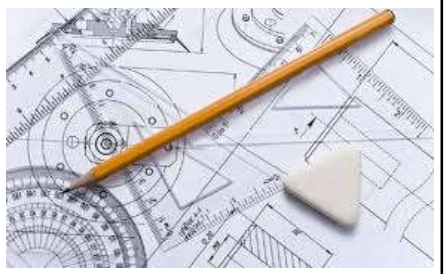
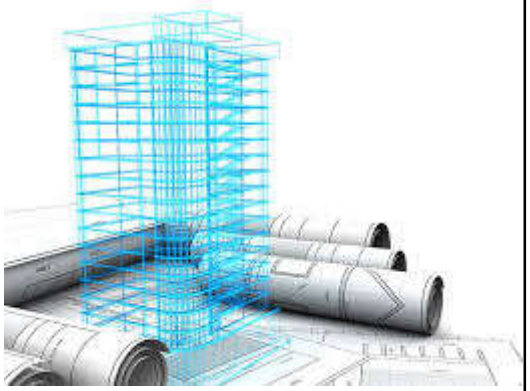
Drawing skills and BIM



- How are your drawing skills?
  - Hand drafting with ink pens and pencils
  - Computer-aided drafting/drawing (CAD) with software e.g. AutoCAD and Microstation
  - 3D models with BIM software
- Basic knowledge:
  - Engineering Drawing
  - Construction CAD by AutoCAD



Drawing skills and BIM

- Architectural documentation
  - Drawings
    - Floor plans, sections, elevations
    - Interior elevations
    - Details, 3D views
  - Documents
    - Descriptions, calculations
    - Schedules
    - Quantity Take-offs (QTOs)
    - Cost Estimations

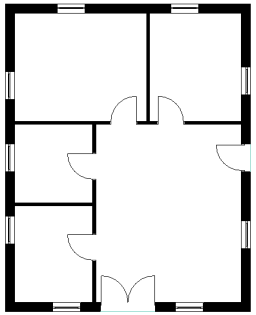
(Source: Graphifsoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Graphical Projections

Ortographic Projections

Planar Views:

- Plan
- Sections
- Elevations

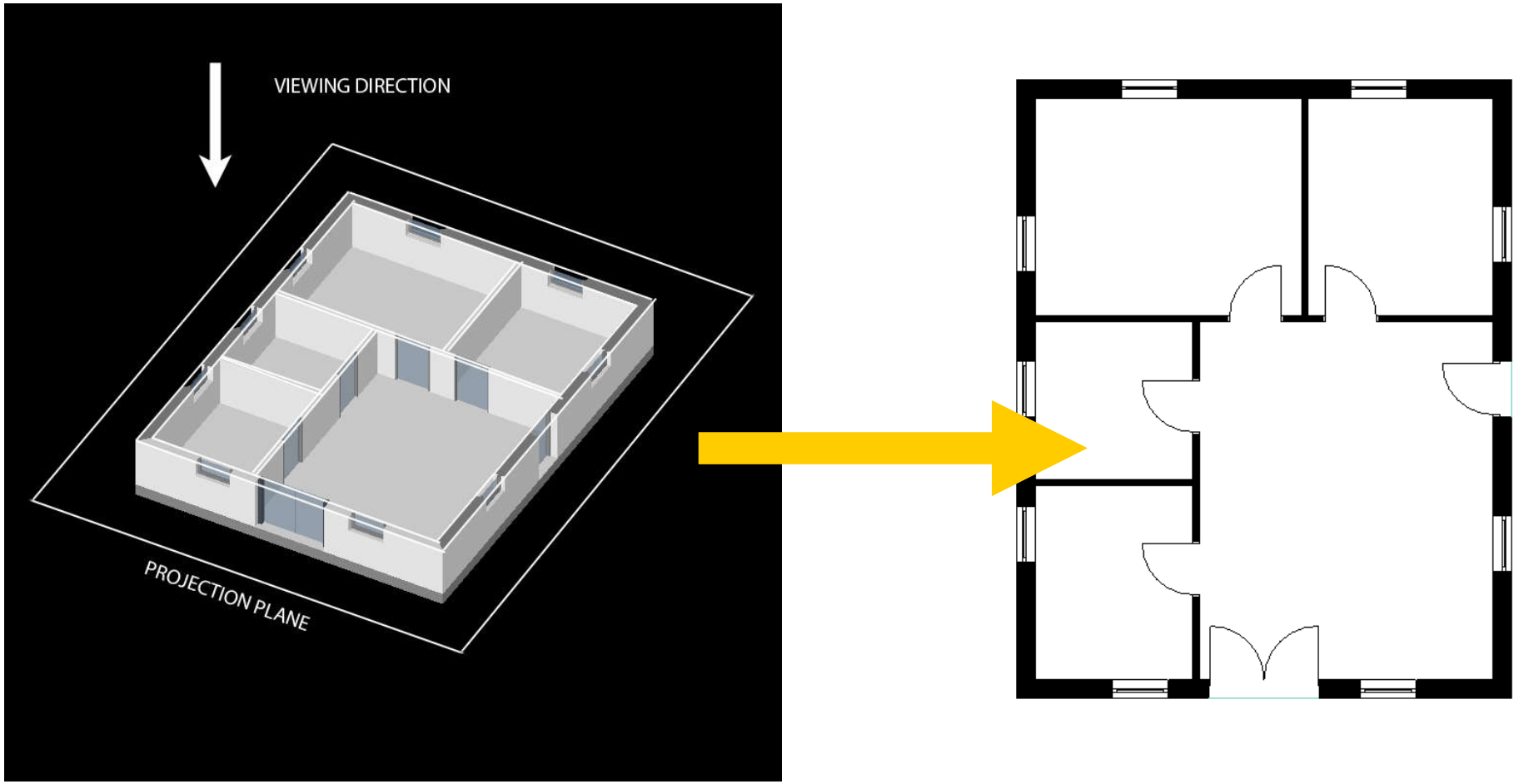


Axonometric Views

Perspective Projections

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Planar Views: Floor Plans



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

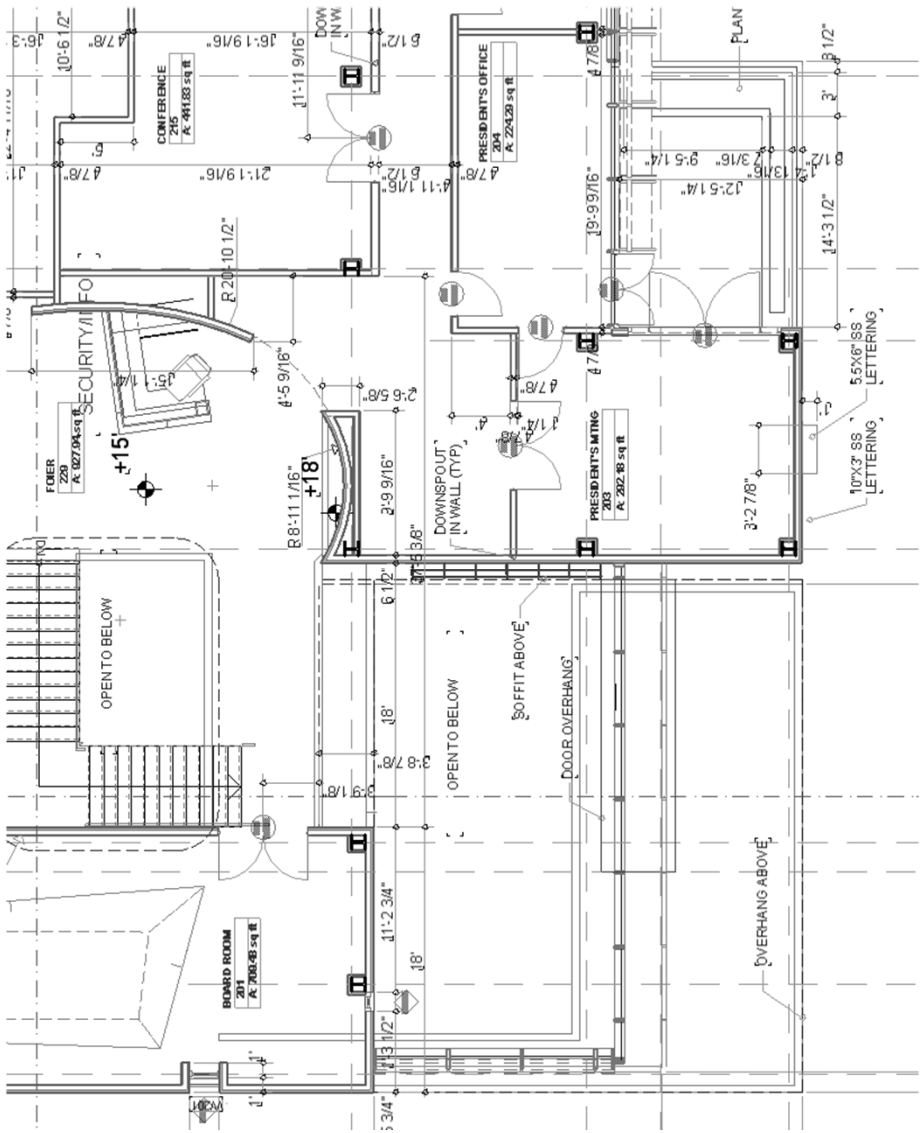
Floor Plans

Drawing Content

- Structural
- Elements
- Mobile & Fix furniture
- Dimensions
- Annotations
- Flooring
- Area info

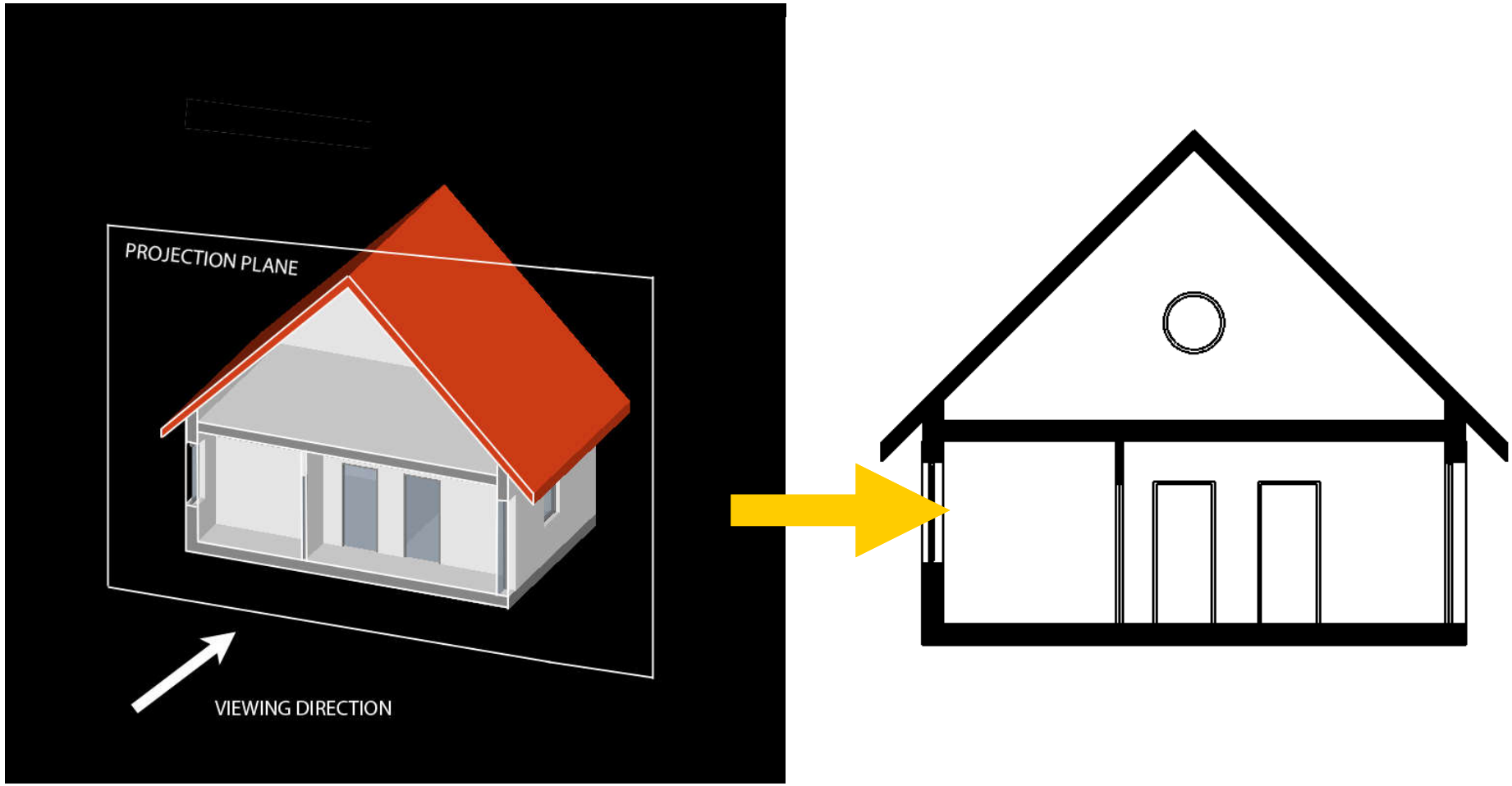
Types

- Architectural
- Structural
- Electrical & Plumbing
- Furnishing
- Reflected Ceiling Plan
- Etc.



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Planar Views: Sections



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

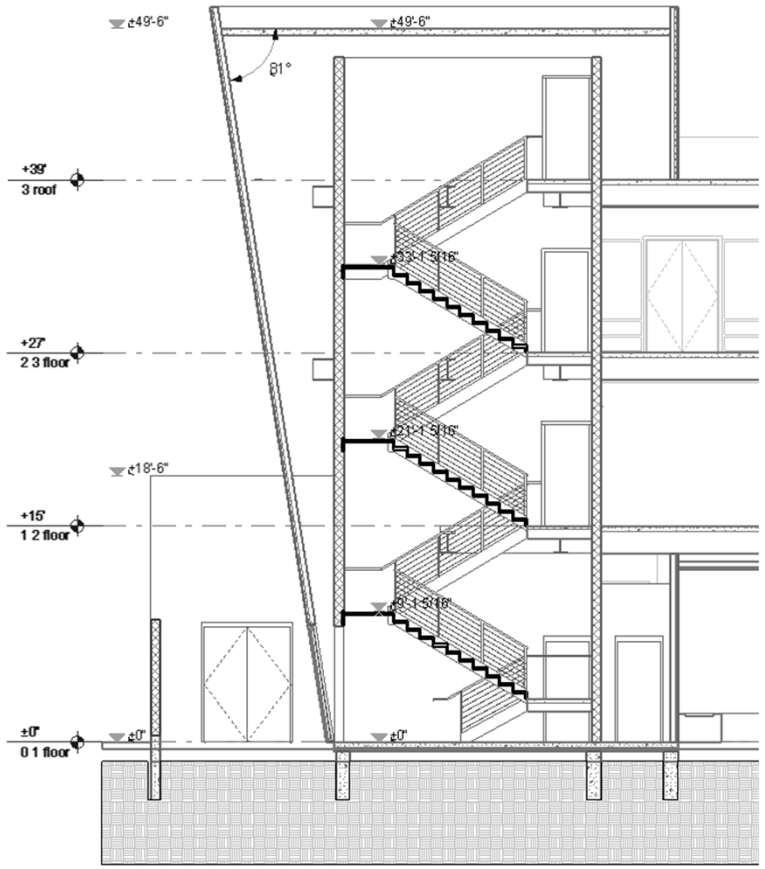
Sections

Drawing Content

- Structural Elements
- Fix Furniture
- Dimensions
- Level Dimensions
- Annotations

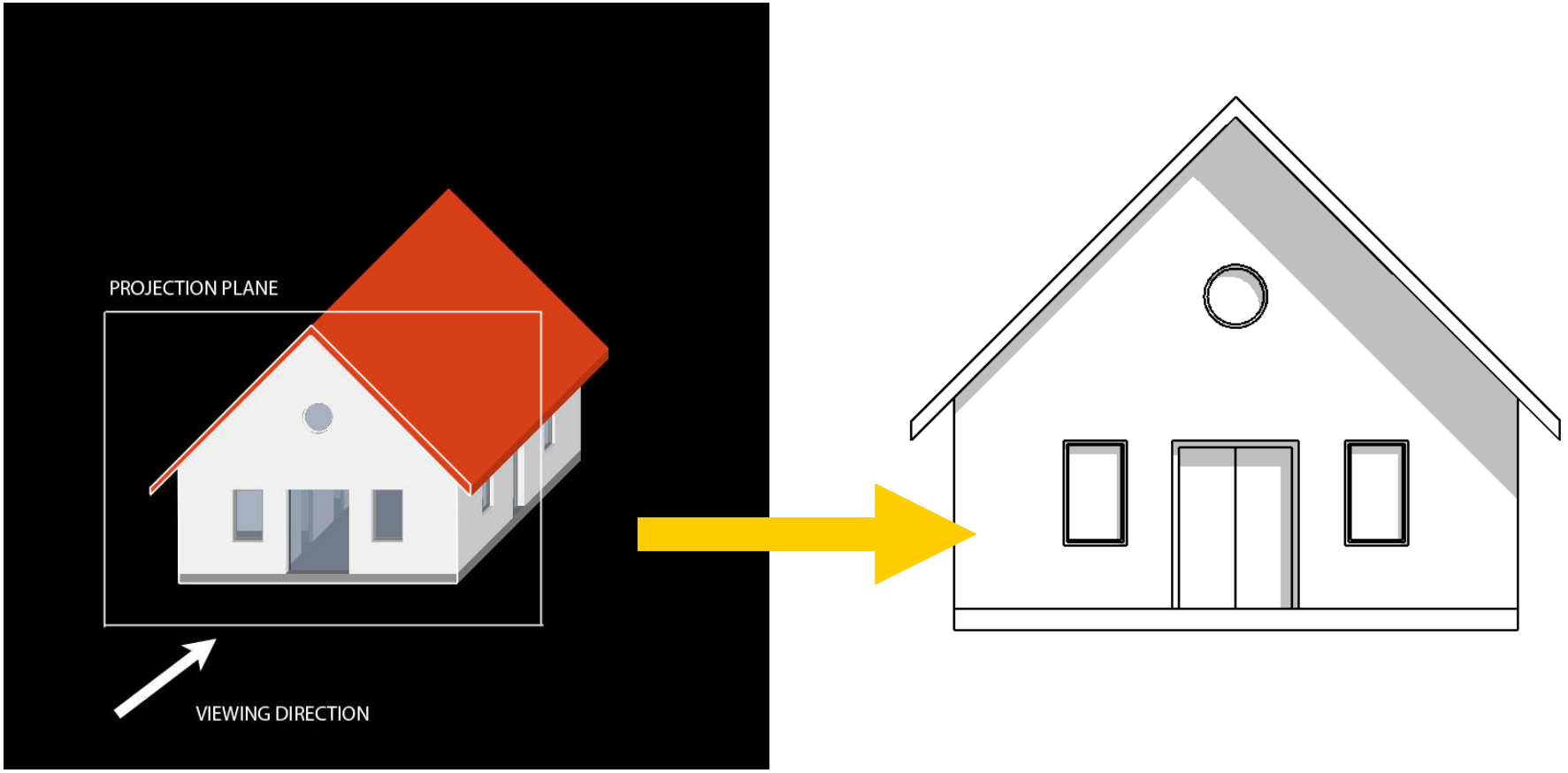
Types

- Architectural
- Structural
- Electrical & Plumbing
- Etc.



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

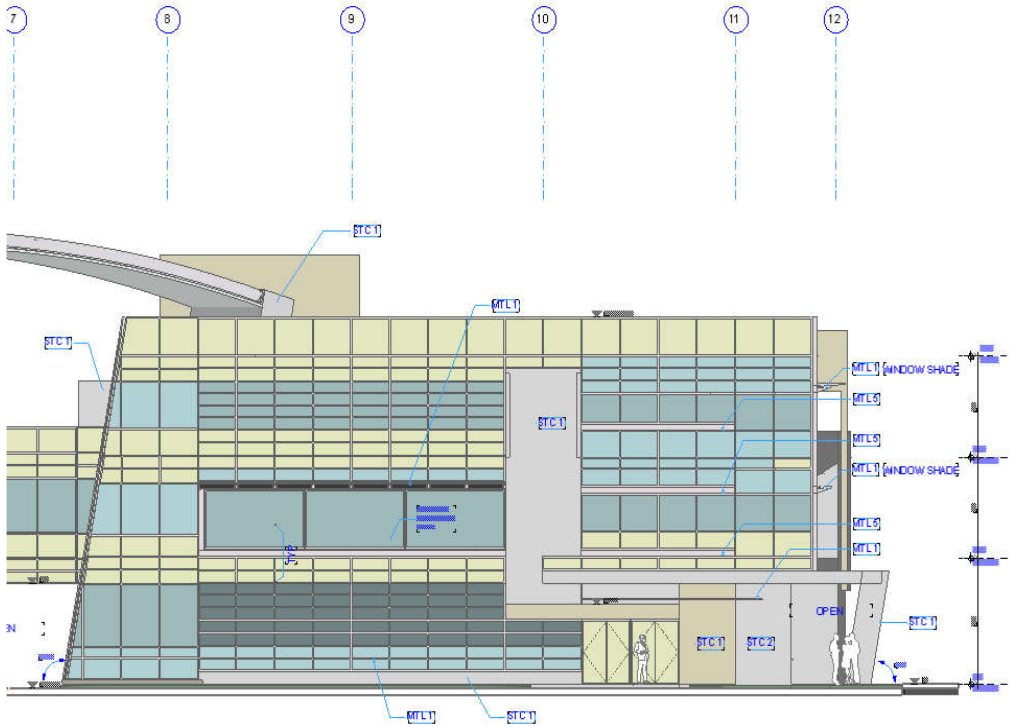
Planar Views: Elevations



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Elevations
Drawing Content

- Exterior Building Elements
- Dimensions
- Level Dimensions
- Annotations
- Material Information
- Colors, Shadows



Types

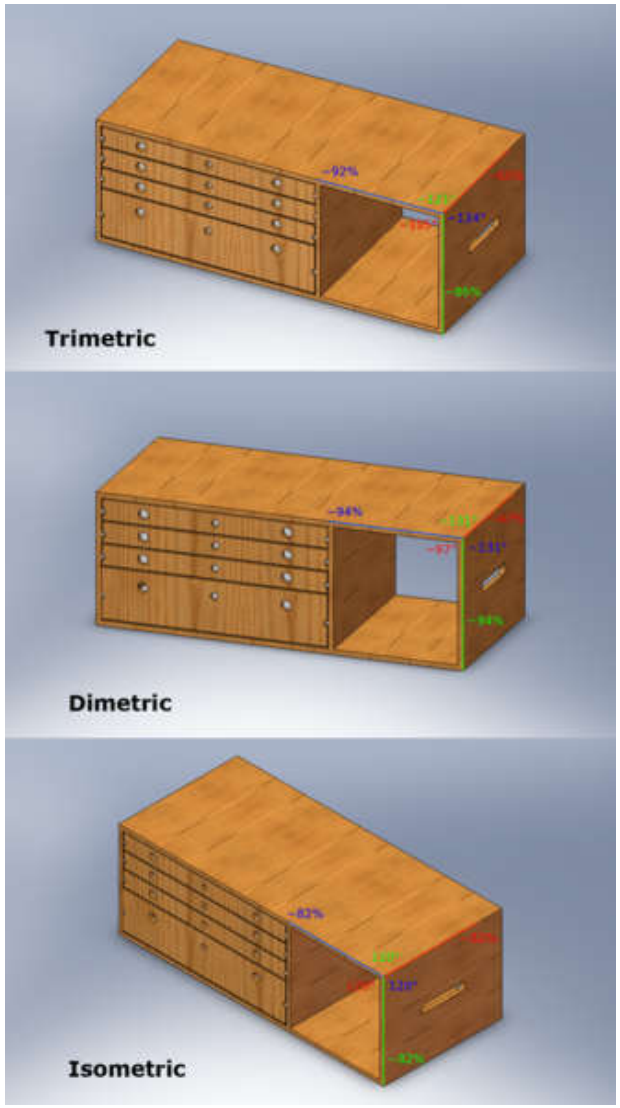
- Architectural
- Structural
- Interior Elevations
- Etc.

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Axonometric Views

Axonometry:
”Image of an object as viewed from a skew direction in order to reveal more than one side in the same picture”

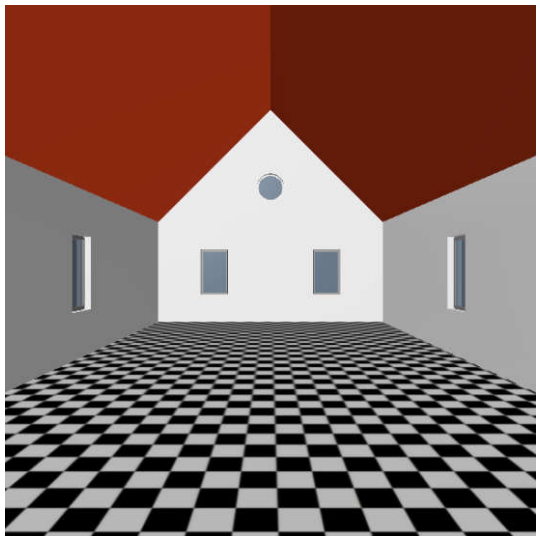
- Basic View Types
  - Trimetric
  - Dimetric
  - Isometric



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Perspective Views

- Basic Types



One-point Perspective

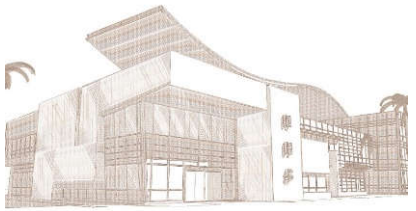
Two-point Perspective

Three-point Perspective

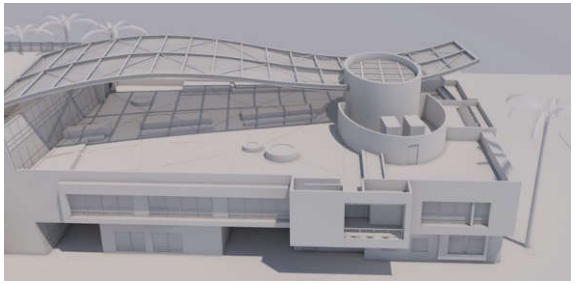
(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

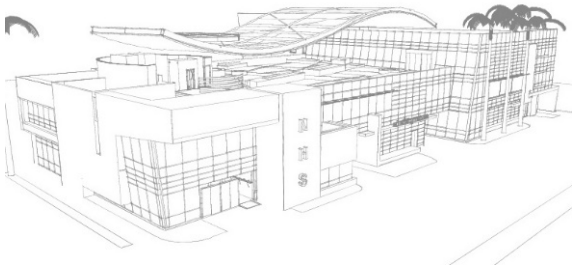
Computer Visualization

- Photorealistic images (rendering)



Artistic images





Interactive virtual models

Fly through animations

Sun studies

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Non-graphic Documentation

- Descriptions
- Instructions
- Calculations
- Lists
- Schedules
- Quantity Take-offs
- Cost Estimations

TEXTFIELD 1
TEXTFIELD 2
TEXTFIELD 3
TEXTFIELD 4

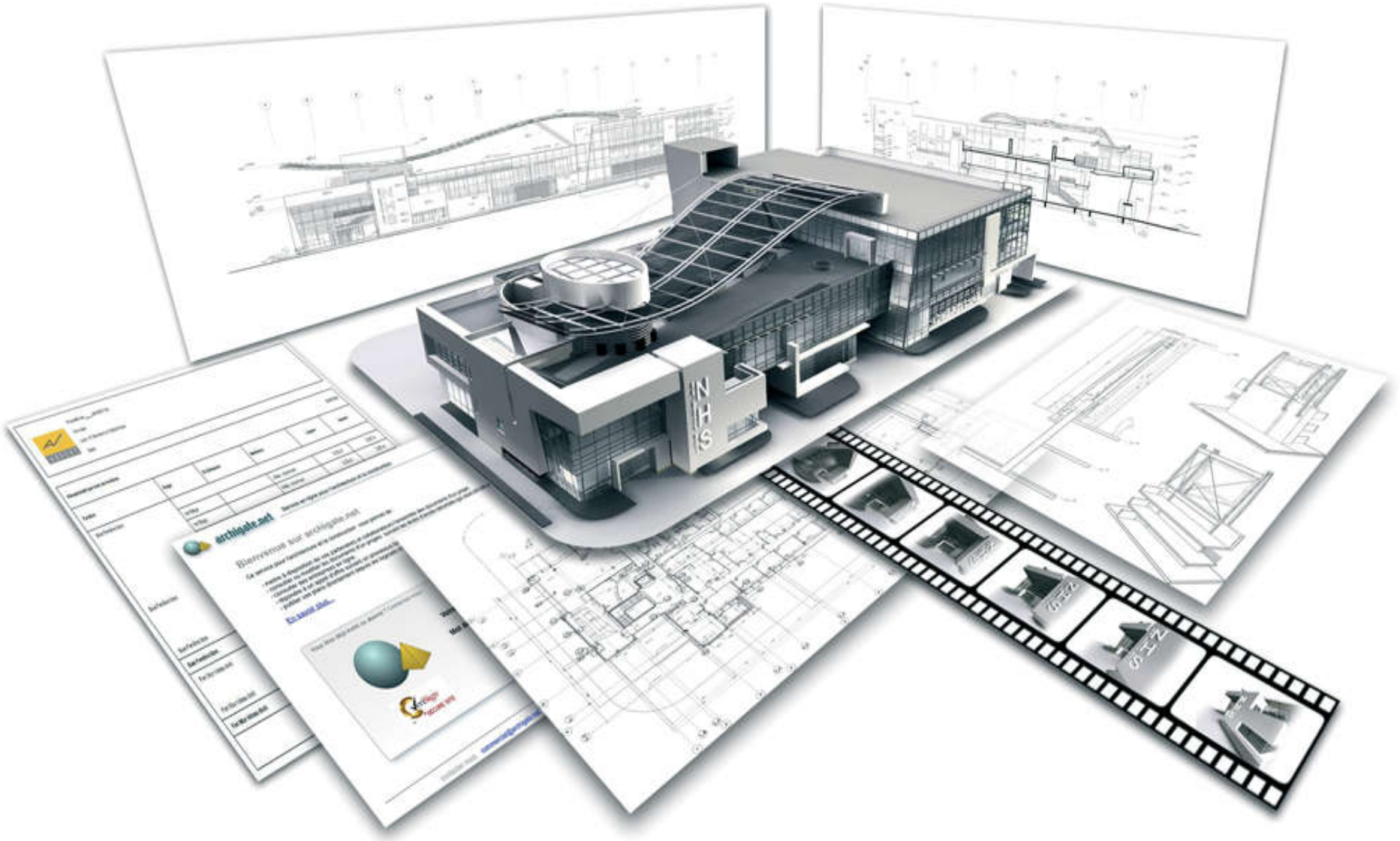
Window Schedule 2006. 03. 06.

W1 Casement	Width:	0,90 m	1 piece(s)
	Height:	1,50 m	
	User ID		W01
	Opening orientation		0
	Material		Wood-Pine

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Basic concepts of BIM

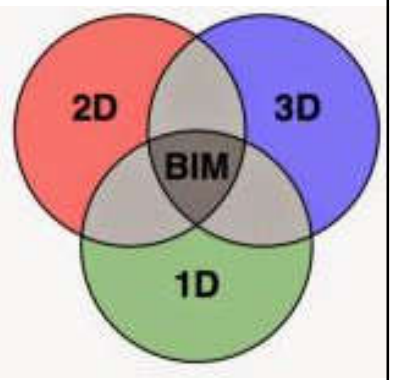
The BIM Concept



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Basic concepts of BIM

- BIM:
  - Building Information Modelling
    - 建築資訊模擬 / 建築資訊模型
  - Building Information Management
- Information and Model
  - 1D: Data/Text information (non-graphical)
  - 2D: Drawings/Diagrams (graphical)
  - 3D: Modelling (geometric information, objects)
  - Object based (with attributes, parametric)

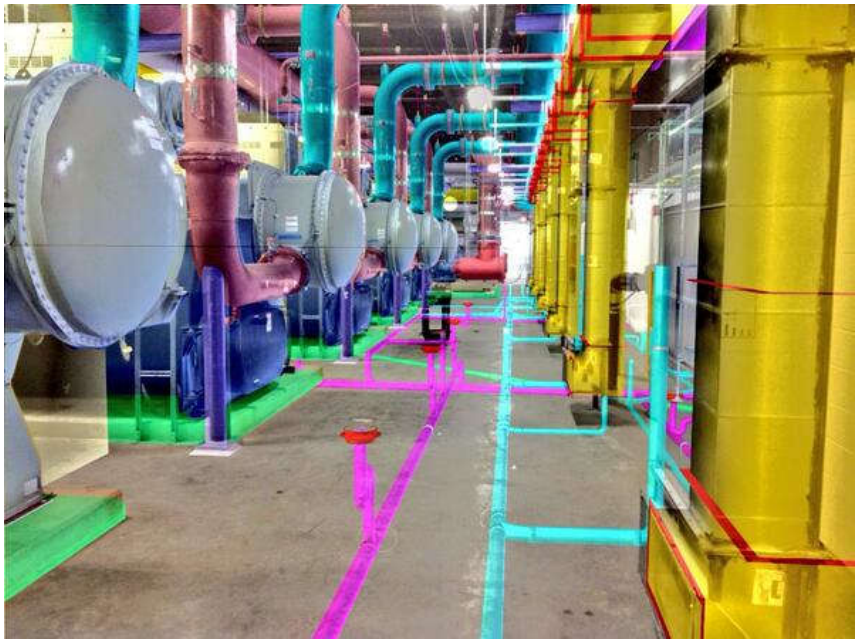


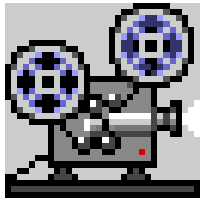
Basic concepts of BIM

- Definition of BIM (from Autodesk)
  - BIM (Building Information Modeling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure
- BIM is not about the B and the M it is about the I = Information is the key

(Source: What is BIM? (Autodesk) https://www.autodesk.com/solutions/bim)

BIM is an intelligent 3D model-based process





Videos: Examples of BIM applications in AEC and building services engineering
- What is BIM (Building Information Modeling)? (3:00) https://youtu.be/suNadRnHy-U
- Introduction: What is BIM? (2:20) https://youtu.be/rAAGRUXNeNQ

Basic concepts of BIM

- National BIM Standard (US): Definition of BIM
  - A Building Information Model (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward.
  - A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM process to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.

(Source: National BIM Standard https://www.nationalbimstandard.org/)

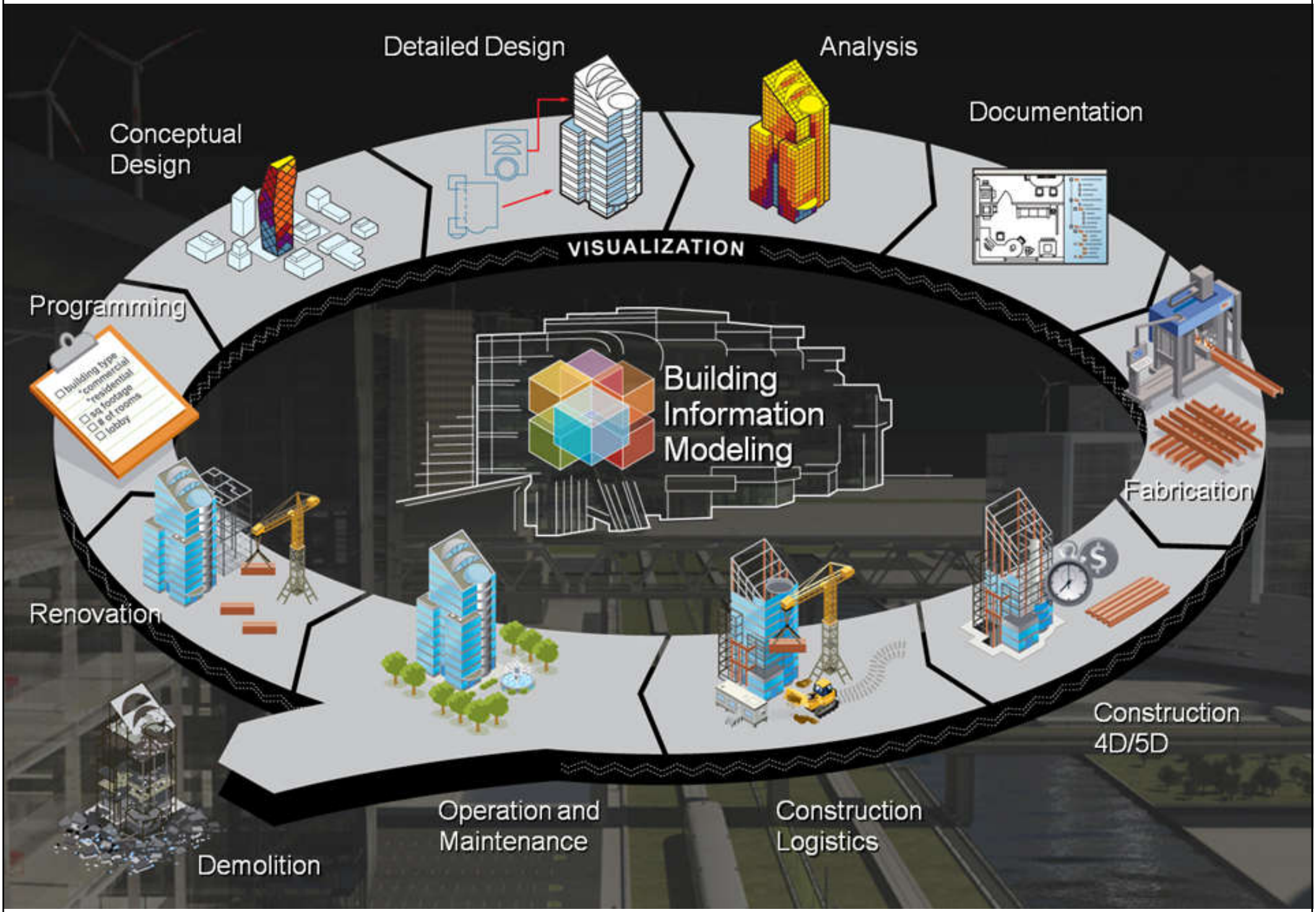
Basic concepts of BIM

- Key concepts of BIM

  - It is a database – not just 3D drawings/images
  - It is all about sharing info through a model with all disciplines (requires all parties to collaborate)
  - Refers to a "model" but it is a "process" not a product (it is a way of working)
  - Working in a BIM environment (a common data environment)
  - Information model => collection of data
  - Connects formerly disconnected silos of info

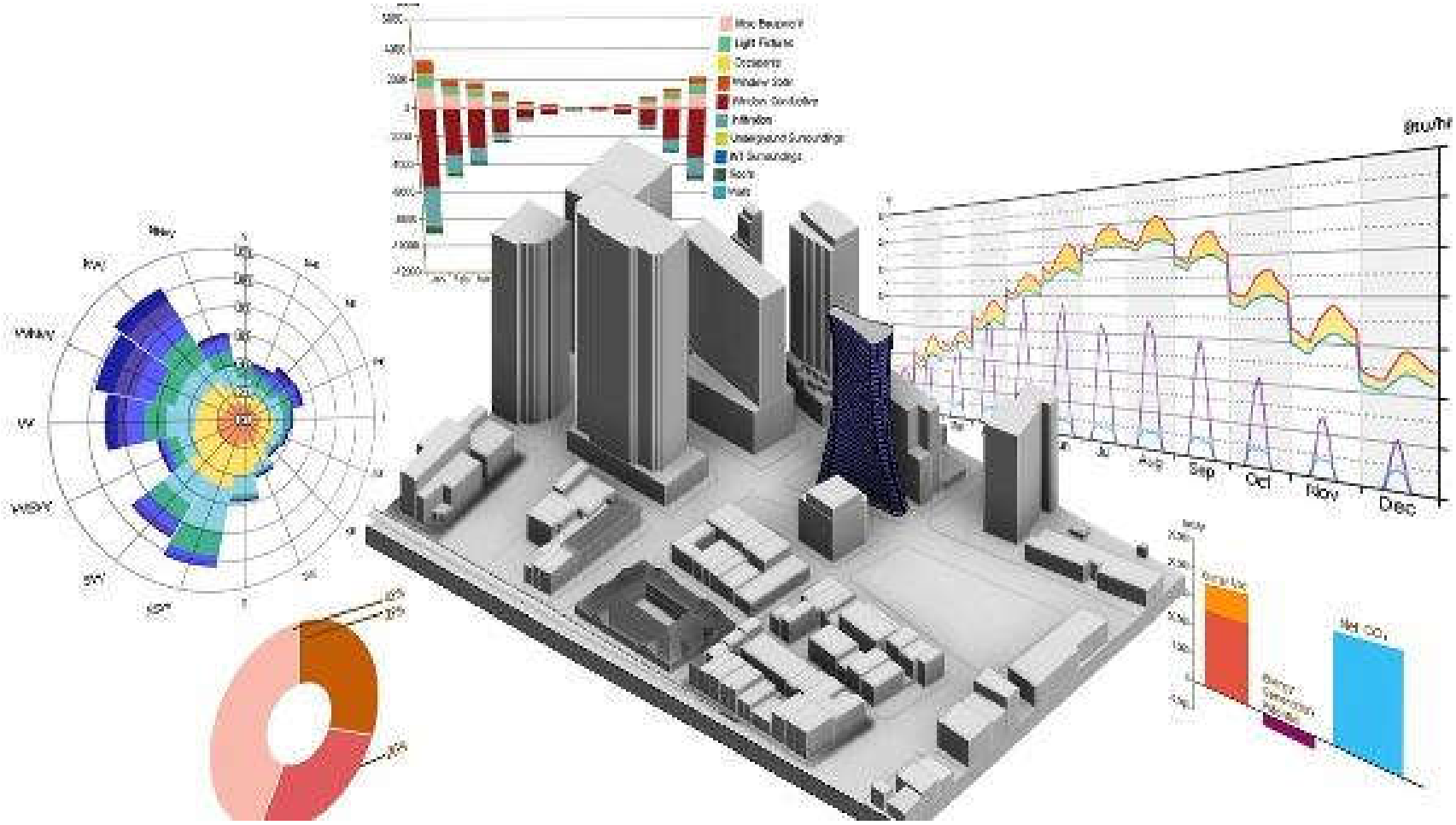
Basic concepts of BIM

- Key concepts of BIM (cont'd)
  - Information models can be used to inform all stages of a built asset's life cycle
  - Ultimate communication tool because it's visual
  - Collaboration to the Nth degree
  - Process + Tools = Power of BIM
  - Enabler for lean construction – can rely on model to help facilitate prefabrication
  - Virtual Design & Construction (VDC) + Analysis + Facility Information = BIM



(Source: Autodesk https://www.autodesk.com/)

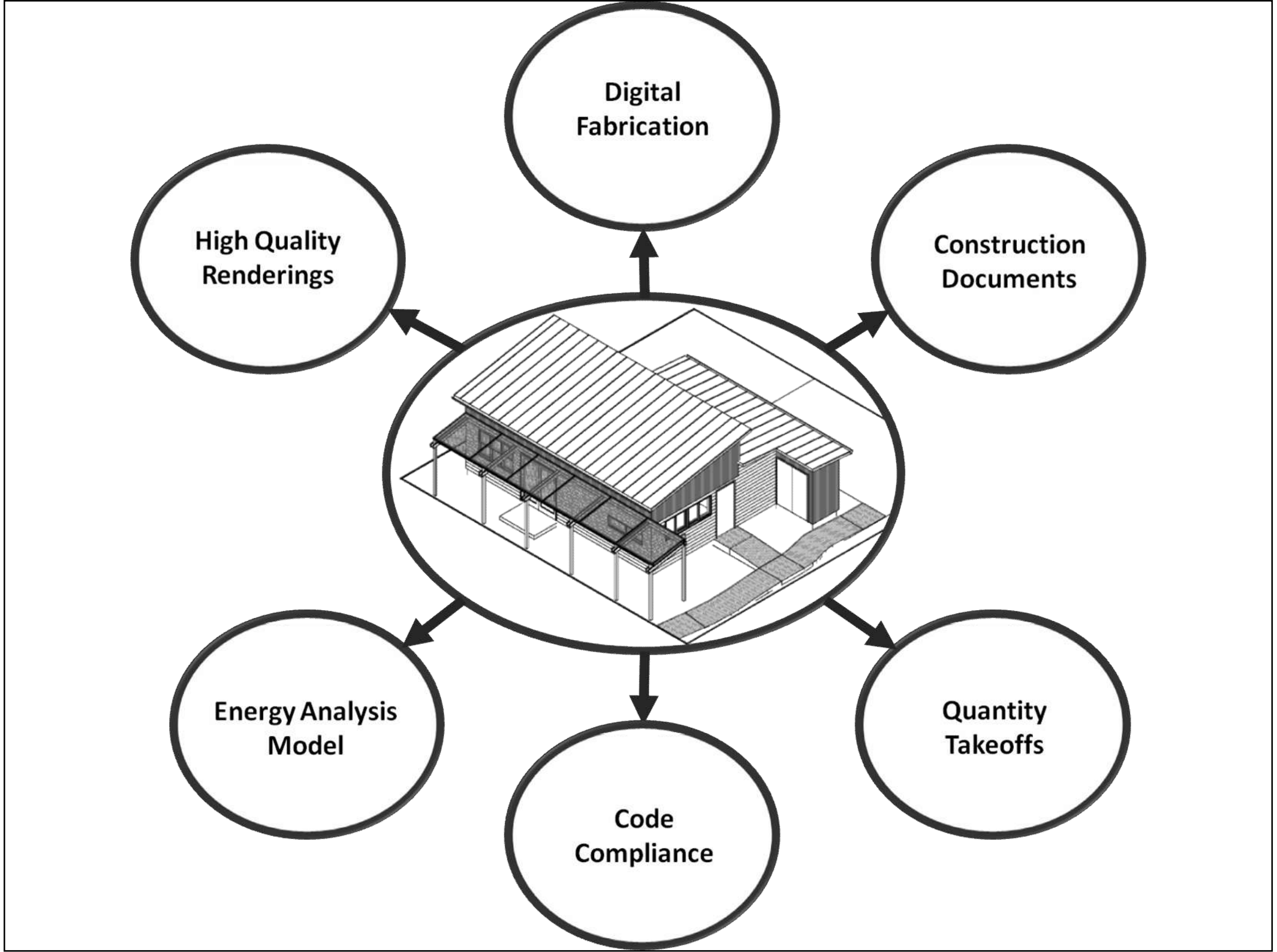
BIM Process + Analysis Tools = Power of BIM



Energy, green building and structural analyses

3D Scanning

Unmanned Aircraft System (UAS) / Drone


Digital Fabrication
High Quality Renderings
Construction Documents
Energy Analysis Model
Code Compliance
Quantity Takeoffs

Basic concepts of BIM

- The BIM information model contains
  - Graphical model: Specific 3-D geometric information such as sizes, areas and volumes
  - Non-graphical data: Cost data, material and component quantities
  - Documentation: Schedule, zoning analysis, environmental performance, instructions for fabrication and construction, reports, manuals
- BIM is a digital design environment

Basic concepts of BIM

- The BIM information model can enable
  - Collaboration among project team members
  - Efficient sketch design
  - Simulation for sustainability, energy and environmental issues, or construction purposes
  - 2D drawing output and numeric export to spreadsheets or other hardware for scheduling or digital fabrication
  - Effective building operation, maintenance & facility management

Basic concepts of BIM

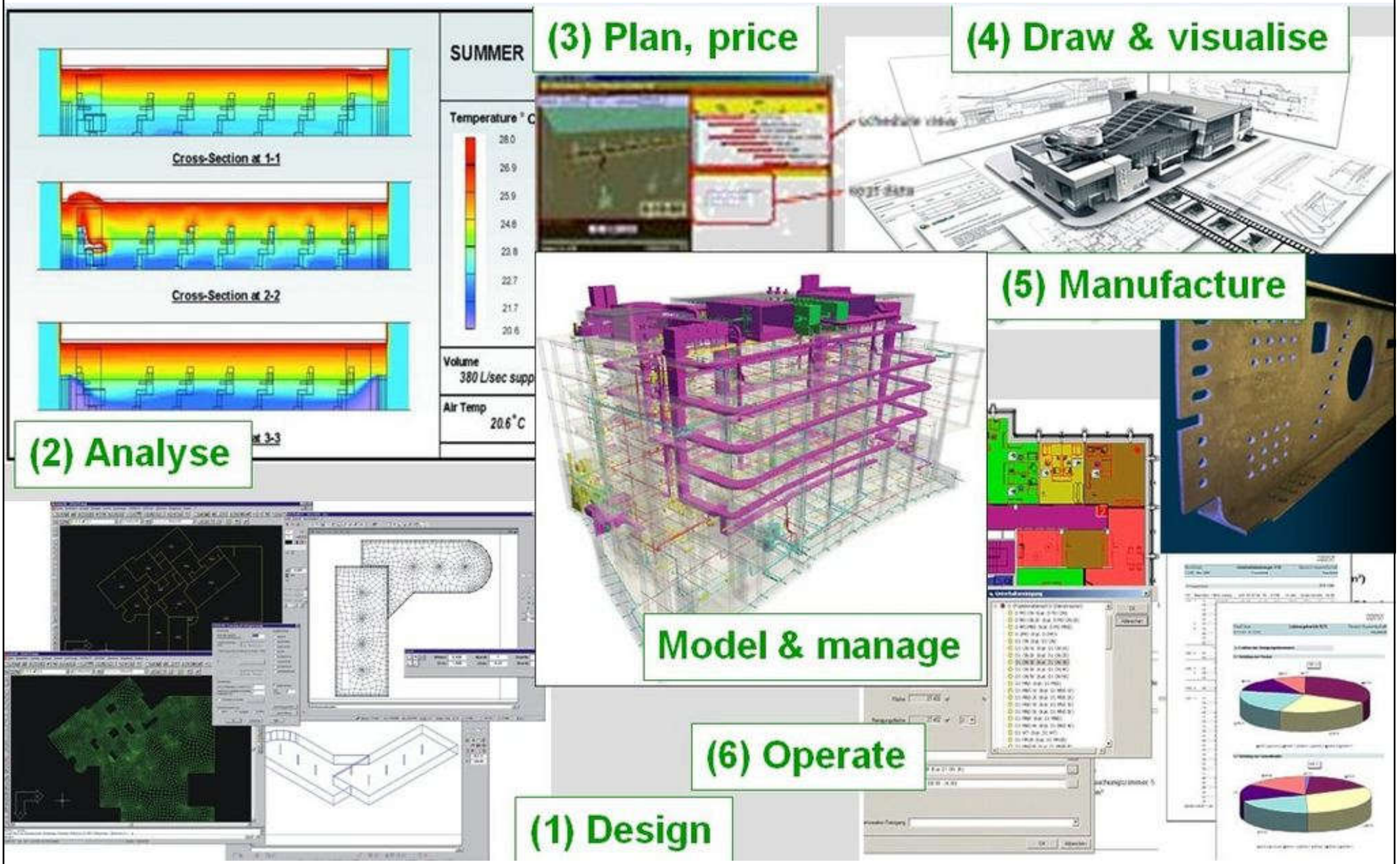
- Based on the use of the information, the BIM information model can be broken down into:
  - 1. Design intent model (by the designer for the designer)
  - 2. Build intent model (by the contractor for the contractor)
  - 3. Fabrication intent model (by the subcontractor for the subcontractor)
  - 4. Facility management model (by the owner for the owner)

Basic concepts of BIM

- Applications for BIM:
  - Architecture
  - Structures
  - Building Services (or MEP)
  - Construction Management, Scheduling
  - Sustainability
  - Utilities
  - Road Construction
  - Property Management

(Source: An Introduction to Building Information Modeling (BIM) https://www.thebalance.com/introduction-to-building-information-modeling-bim-845046)

Practical uses of BIM model and information



Examples of BIM use in building, construction and infrastructure

• Existing conditions modeling • Site analysis • Architectural programming • Quantities Take Off (QTO) • Cost analysis • LCC analysis • Specification production • Design authoring and briefing • Sustainability evaluation • Engineering analysis • Energy analysis • Structural analysis • Lighting analysis • Mechanical analysis • Other engineering analysis	• Building system analysis • 3D coordination • 3D control and planning • Site utilization planning • Product library • Product selection • Perform procurement • Manufacturers information (incl. LCA) • Code compliance checking • Design reviews • Consistency control • Construction system design • Digital fabrication • Phase planning (4D modeling) • Commissioning	• Record modeling • Asset management • Space management and tracking • Disaster planning / emergency preparedness • Building (preventative) maintenance • Scheduling • Security & key management • Telephone move/add/change management • Way finding • Facility management (FM) documentation • Maintenance & repair information

(Source: buildingSMART alliance)

Why BIM?

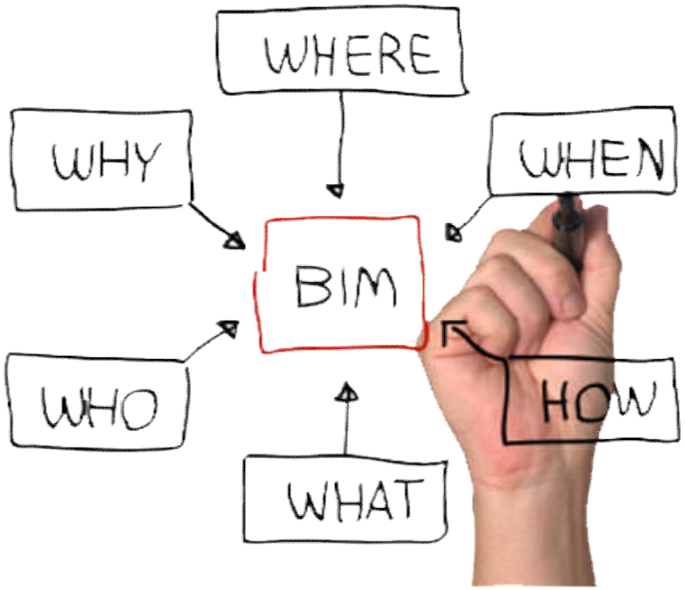
Why BIM?

- Examine problems of construction projects
  - Owner has “clouded” vision of final deliverable
  - Inaccurate/Incomplete plans/specs
  - Trades are picked by lowest price (in most cases no “value added” assigned to competence)
  - Nobody will share info because of liability
  - Everyone wants to shove risk to someone else
  - Because the job is awarded on low price, subs need to make up money on change orders

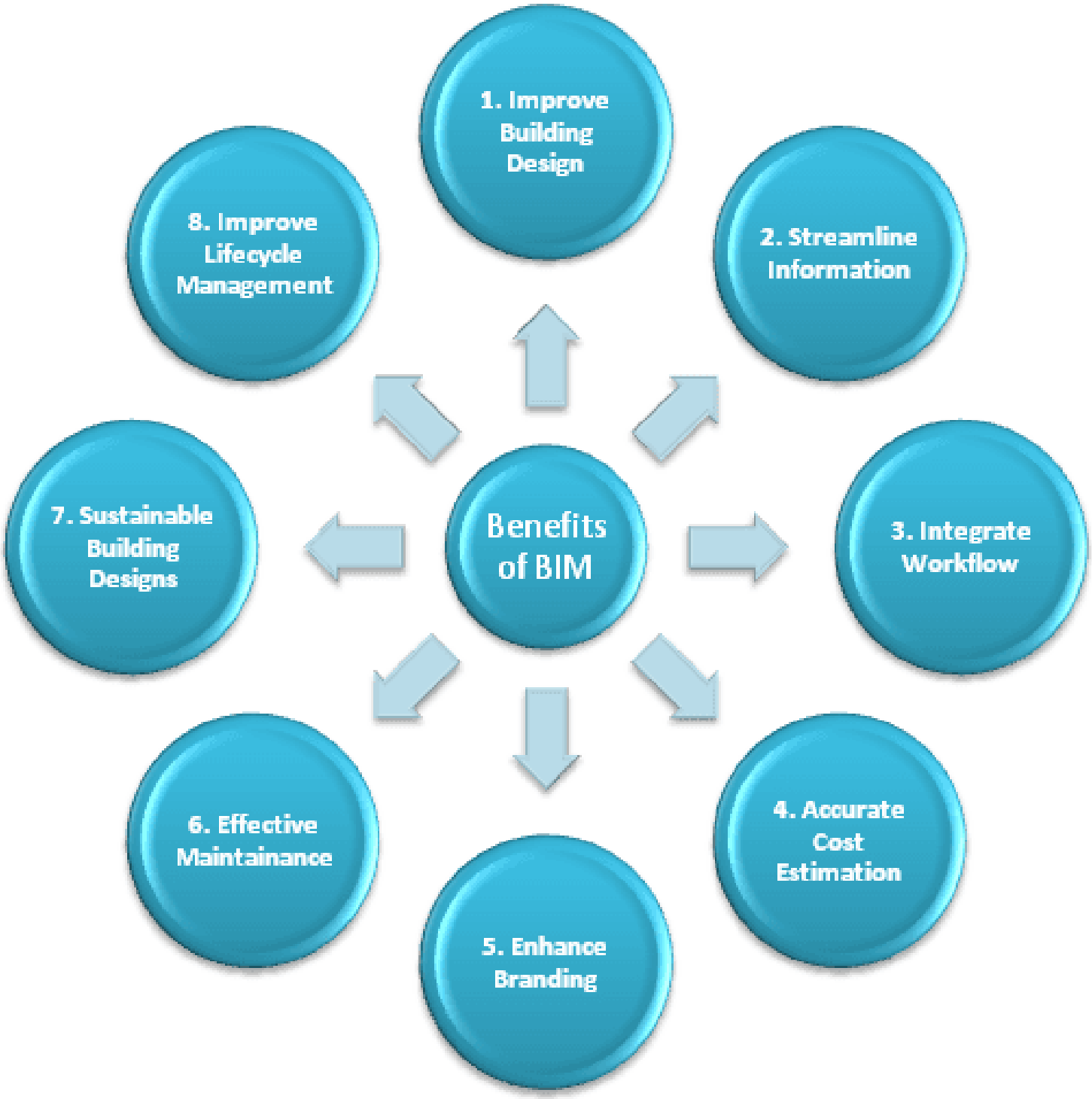
(See also: What is BIM? (4:54) https://youtu.be/PLoUVZjW21g)

Why BIM?

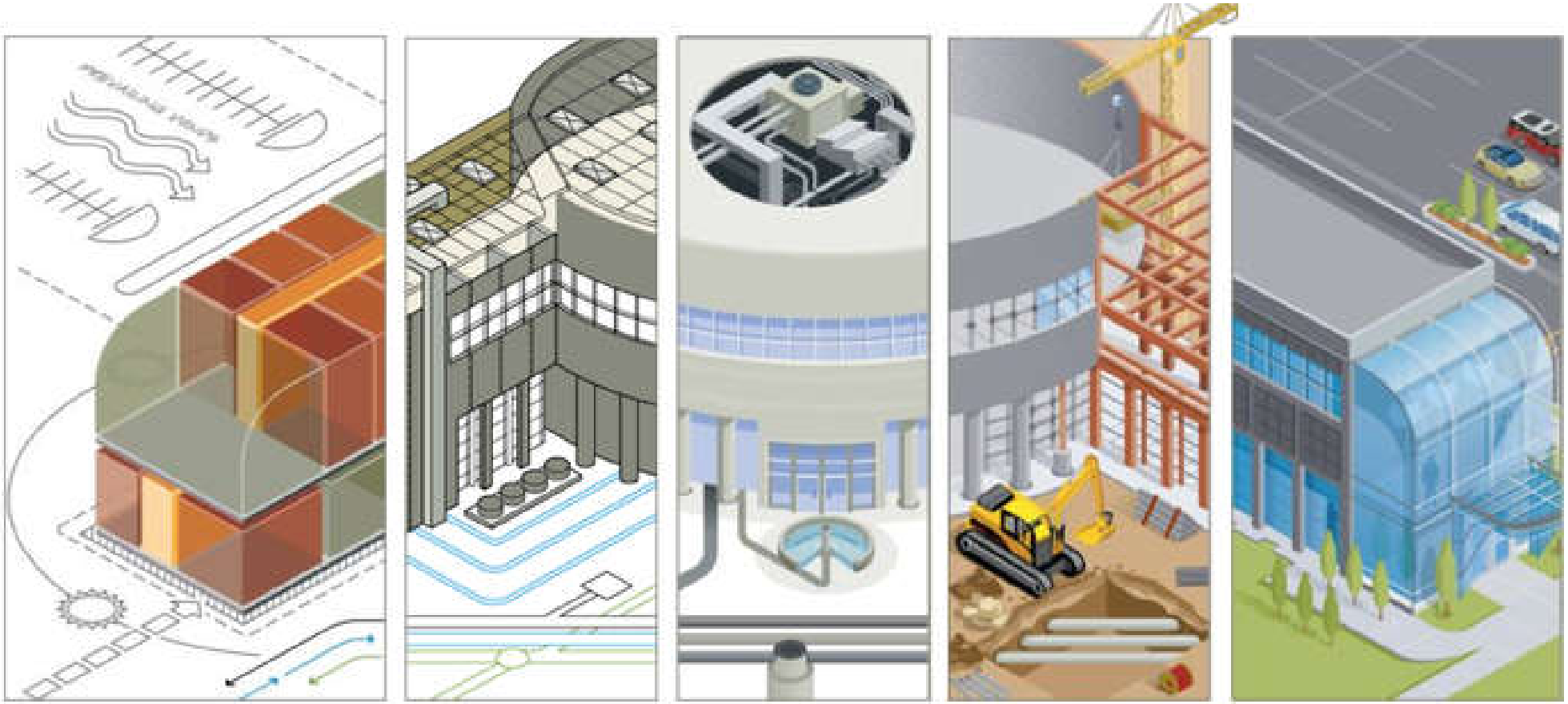
- Biggest BIM adoption hurdles:
  - Lack of BIM expertise
  - Lack of industry standards
- Greatest BIM benefits:
  - Improved communication
  - Improved collaboration
  - Higher quality project decision making
  - More comprehensive planning and scheduling



Benefits of BIM



Use of BIM throughout building project development cycle



Conceptualization **Design** **Implementation** **Construction** **Own/Operate**

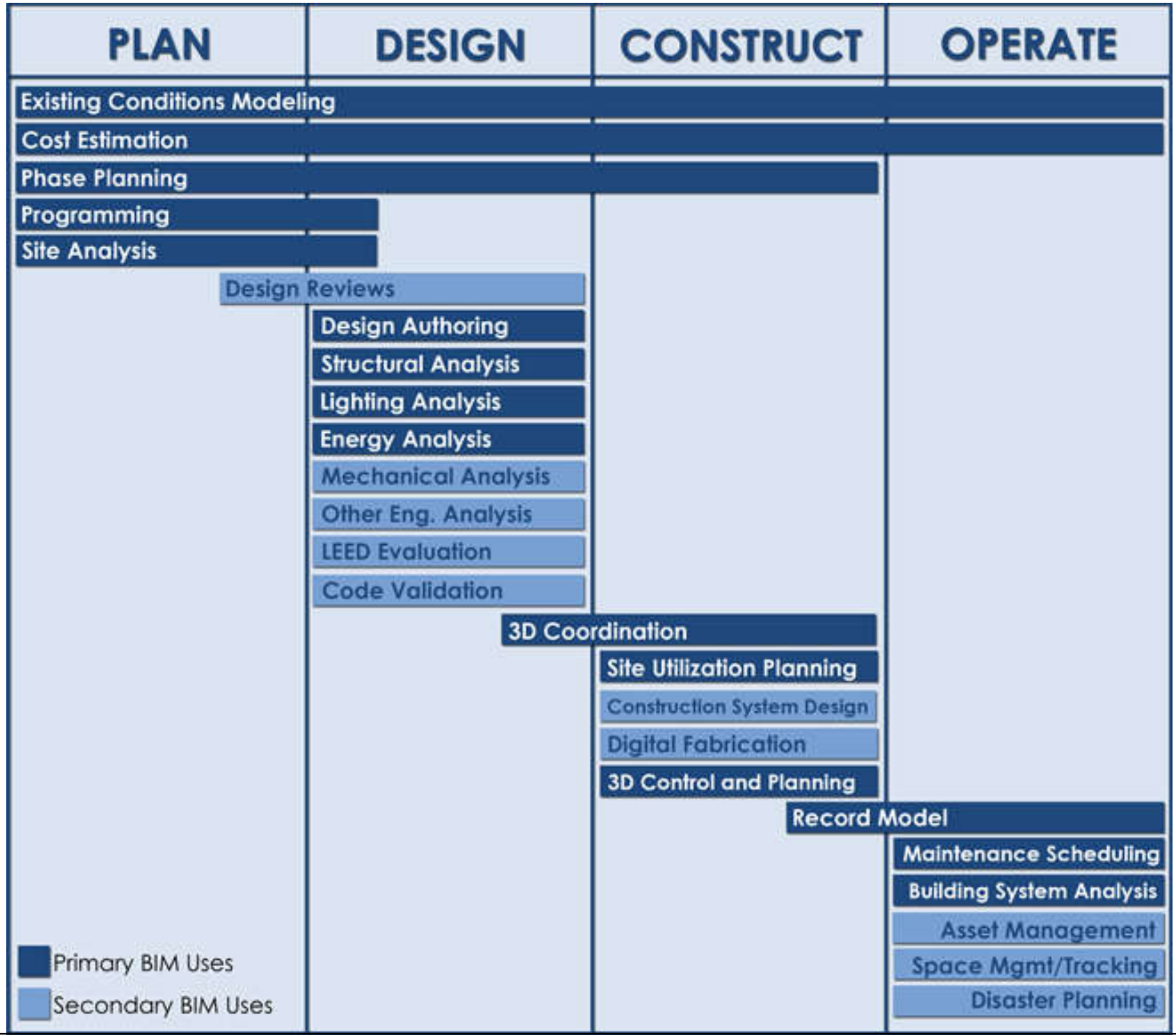
Docs

- Collaborative processes
- Key stakeholders contribute expertise
- Improved decision-making and quality

- Controlled by precise design model
- Improved coordination and documentation

- Early planning = efficient material use, less waste
- Change orders are minimized
- Construction: on schedule/budget

Primary and secondary BIM uses in building process



Why BIM?

- BIM creates efficiency and business benefits
  - Reduce rework
  - Improve productivity
  - Reduce conflicts and changes during construction
  - Clash detection and avoiding rework
  - Promote new BIM-related services
  - Reduce errors and omissions in construction documents

(Source: Building Information Modeling (BIM) Benefits Per Profession https://www.thebalance.com/building-information-modeling-bim-benefits-845045)

Why BIM?

- BIM provides a single, intelligent model to coordinate the following information:
  - Construction documentation
  - Visualisation (design and construction)
  - Material and equipment quantities
  - Cost estimates
  - 4-D construction sequencing and reporting
  - Scheduling
  - Fabrication data and toolpaths

(Source: Garber, R., 2014. *BIM Design: Realising the Creative Potential of Building Information Modelling*)

Why BIM?

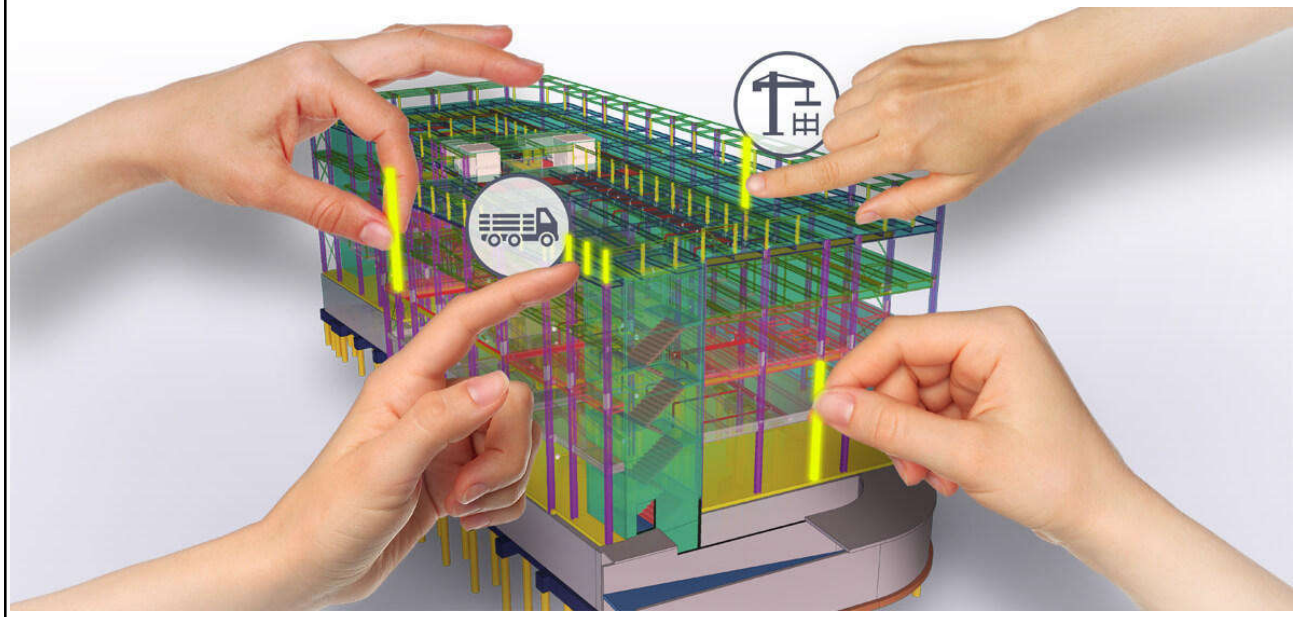
- By adopting an information-modelling platform, building designers can:
  - Visualise multiple design organisations
  - Simulate alternatives
  - Identify clashes between building equipment
  - Communicate design intent three-dimensionally
  - Improve productivity
- BIM will ultimately replace the CAD tools with an integrated, parametric database

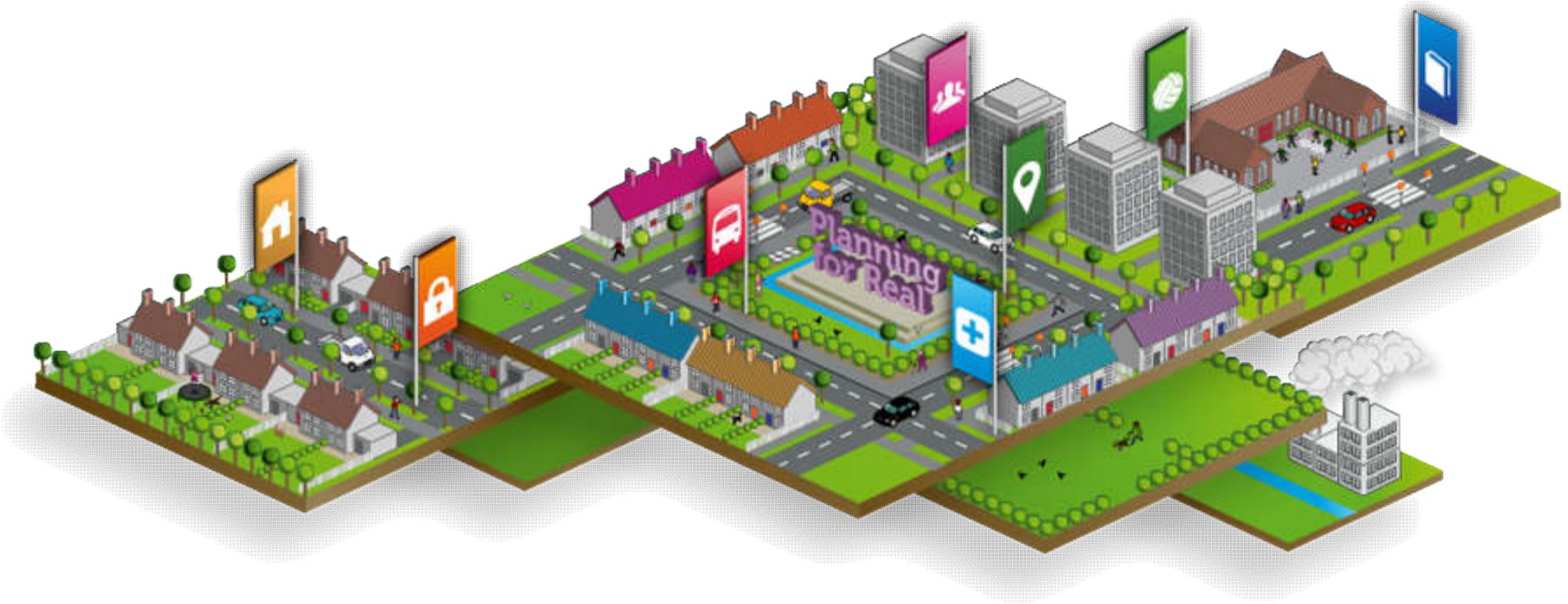
(Source: Garber, R., 2014. *BIM Design: Realising the Creative Potential of Building Information Modelling*)

Why BIM?

- Digital design environment/tools
  - Bring about process change & paradigm shift
  - Simulate the design virtually (like a "*rehearsal*")
  - Attributes such as cost data and construction sequence can be input
- BIM & virtual design and construction (VDC)
  - Management of integrated multi-disciplinary performance models of design-construction projects

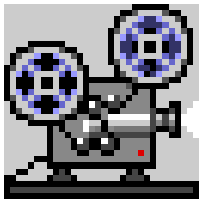
Virtual design and construction (like playing computer games)





Why BIM?

- Virtual design and construction (VDC)
  - An overall framework for conceiving and designing projects using multidisciplinary computer-generated models that illustrate and analyze the entire life cycle of the project, including the design and construction processes, schedule, logistics and cost
    - Virtual Design and Construction (VDC) at Parsons Brinckerhoff (2:21) https://youtu.be/KmRu1rRPRis
    - Virtual Design and Construction (VDC) overview (2:40) https://youtu.be/Y6qJ_KG6Jwo



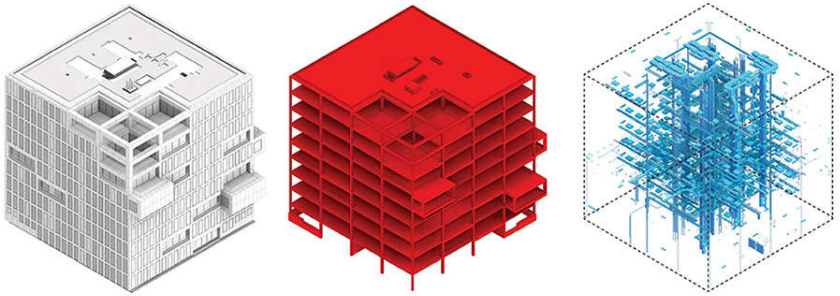
Why BIM?

- Elements of virtual design and construction (VDC)
  - 1. Engineering modelling methods
    - Product, organization, process
  - 2. Analysis methods (model-based design)
    - Including quantities, schedule, cost, 4D interactions and process risks (i.e. BIM tools)
  - 3. Visualization methods (graphics, movies, virtual reality)
  - 4. Business metrics - within business analytics - and a focus on strategic management
  - 5. Economic impact analysis, i.e., models of both the cost and value of capital investments

(Source: Virtual design and construction - Wikipedia https://en.wikipedia.org/wiki/Virtual_design_and_construction)

BIM elements and standards

- Typical elements:
  - Architecture, MEP (Building Services), Structure
- Information:
  - Model based documentation
  - Calculations and analyses

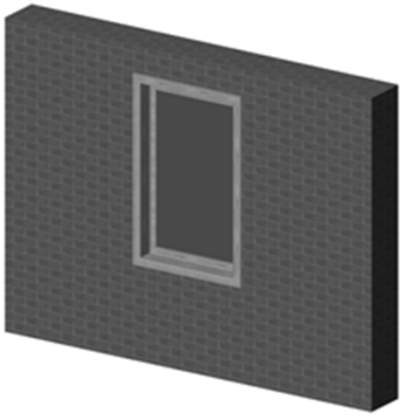


- Collaboration
  - External, internal, teamwork
- BIM Standards, e.g. in UK and USA

BIM - Real Architectural Elements

Drawing representation

- Floor plan, section and elevation views
- Adjustable contours, fills, backgrounds
- Scale sensitivity

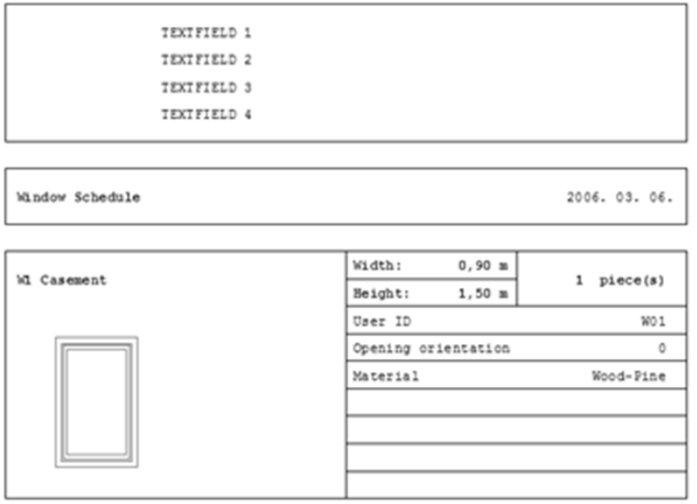


Model representation

- 3D shapes connected to drawing element
- Surface color and texture

Non-graphical information

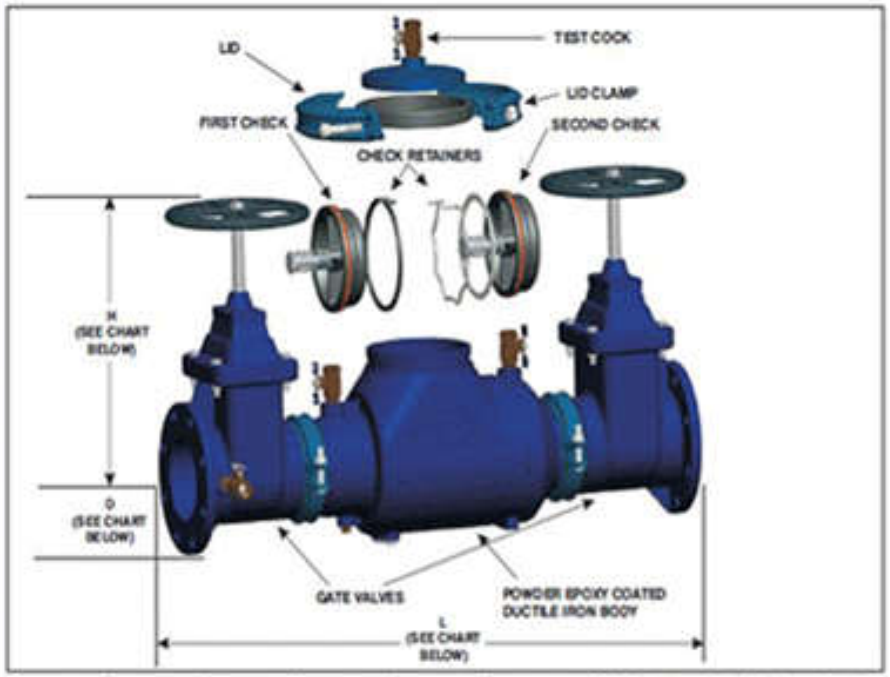
- Material descriptions
- Quantities, volumes
- Cost



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Example of MEP (Building Services) elements: A valve

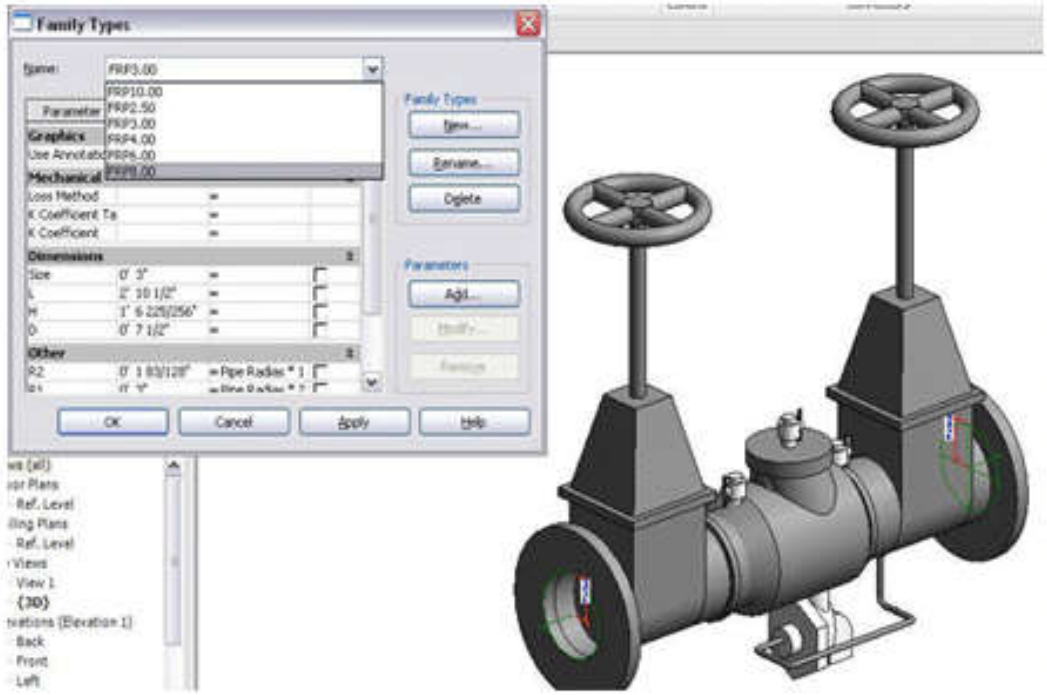
INPUT



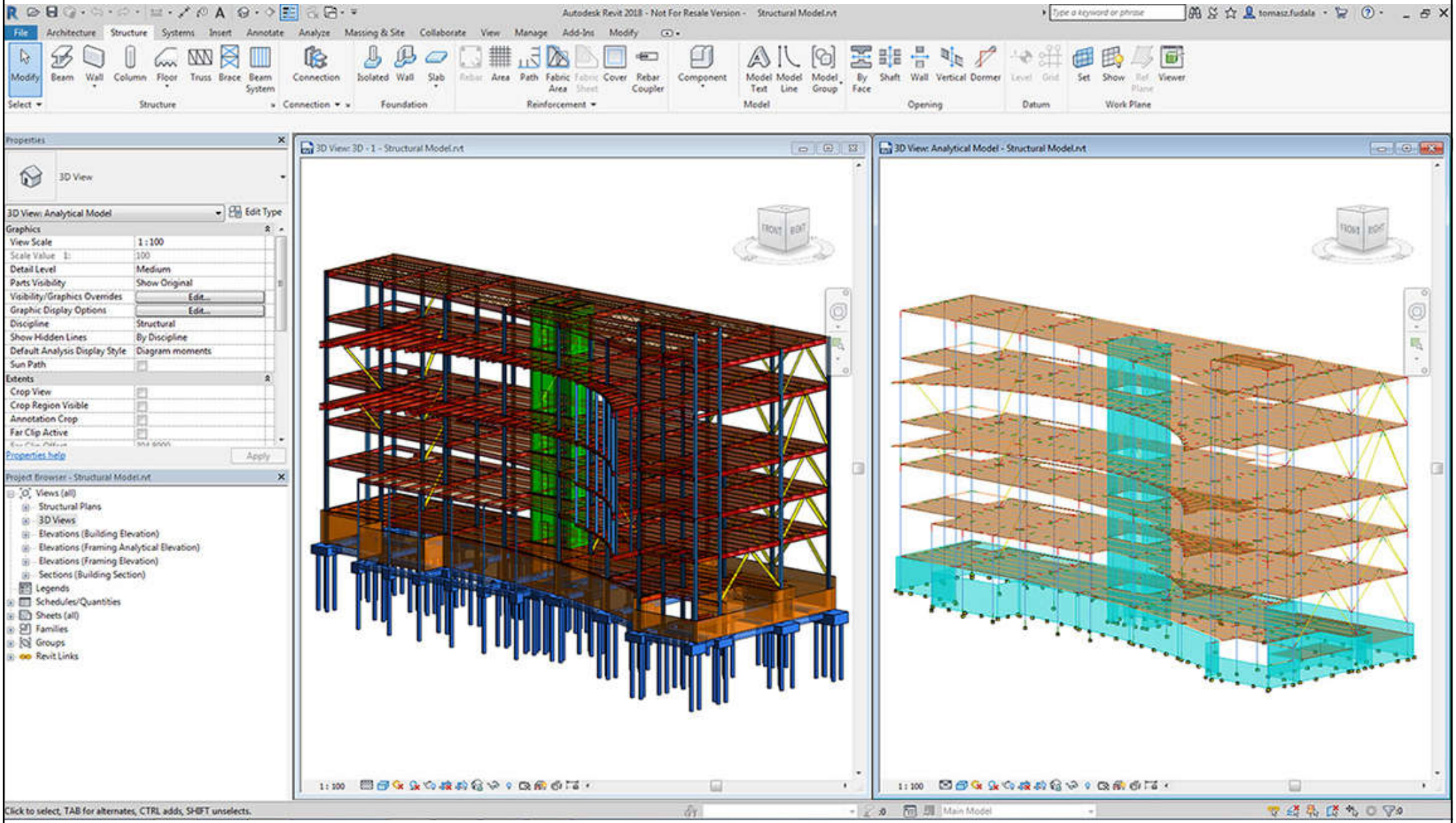
Model No.	Size	L	H OSY OPEN	H NRS	D
FDC2.50	2 1/2"	33.5	18.88	16.38	7
FDC3.00	3"	34.5	21.88	18.88	7.5
FDC4.00	4"	40.8	25.63	21.63	9
FDC6.00	6"	43.8	35.13	29.13	11
FDC8.00	8"	56.5	44.63	36.63	13.5
FDC10.00	10"	59.5	54.5	44.5	16

OPTIONAL VARIATIONS:	SUFFIX
☐ Non Rising Stem Gate Valve	-NRS
☐ Outside Stem and Yoke Gate Valve	-OSY
☐ Meets Buy America and Pennsylvania Steel Act	-BA
☐ Strainer attached	-S
☐ Double Check Detector Assembly	-DCDA
☐ Grooved Flange Connection	-G
☐ No Gate Valves	-LF

OUTPUT



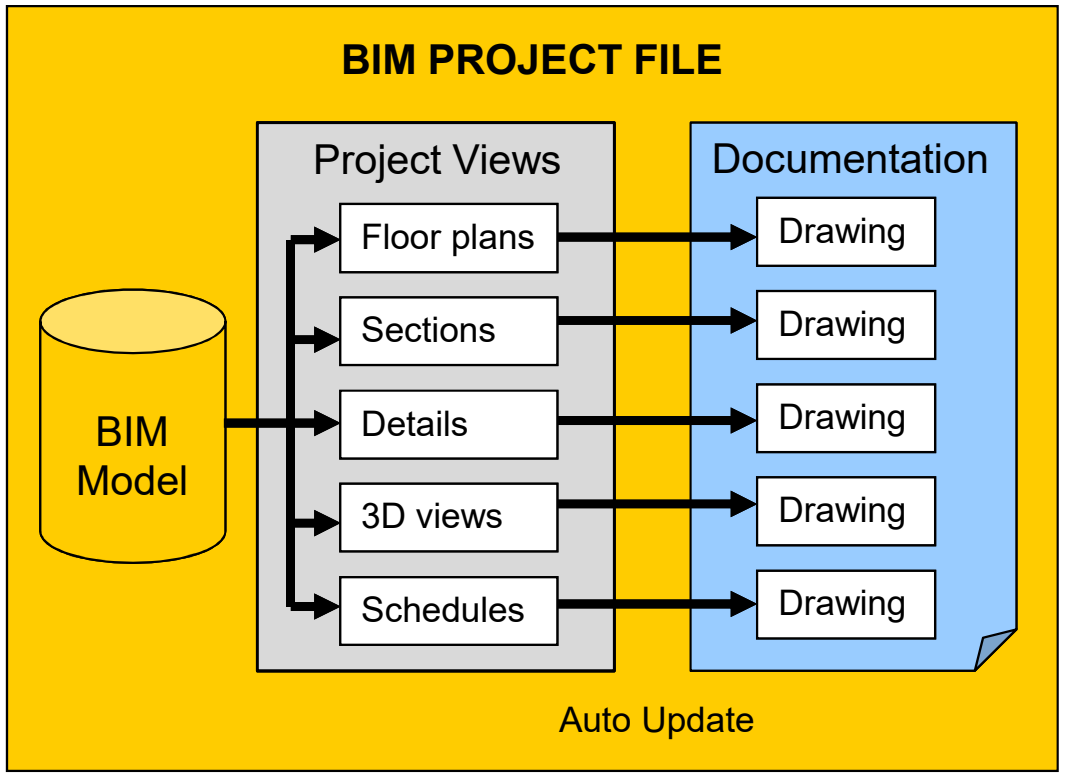
BIM structure elements and structural analysis



(Source: Autodesk Revit Structure)

BIM - Model Based Documentation

- Coherence between model and drawing
- All drawings derived from the model
- Model coordinates drawings
- Scale sensitive elements
- The complete project lifecycle can be controlled from a single file
- Rich 3D visualization content



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

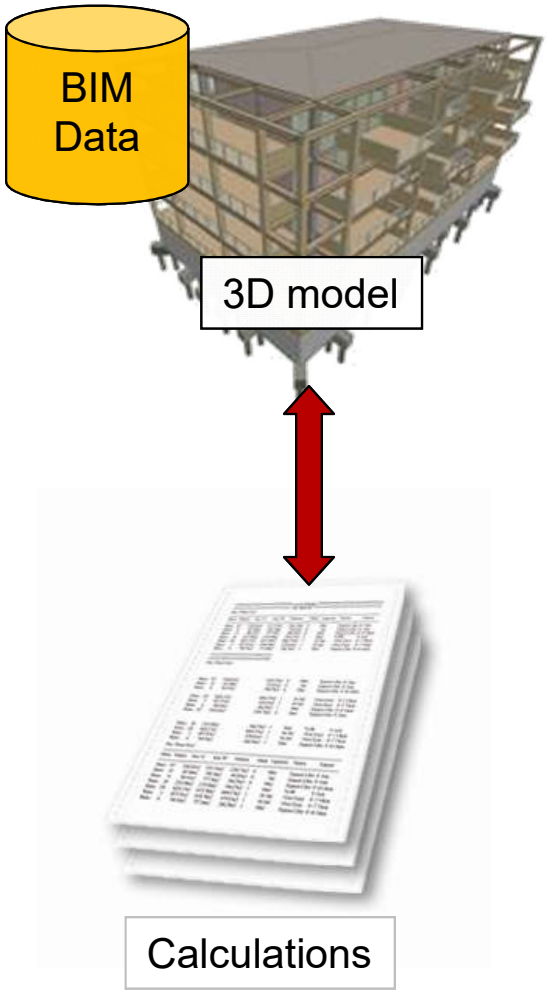
BIM - Calculation

Additional information attached to a model

- Quantity
- Materials
- Descriptions
  - Product details
  - Construction details
  - Safety details
- Cost

Instant Calculation

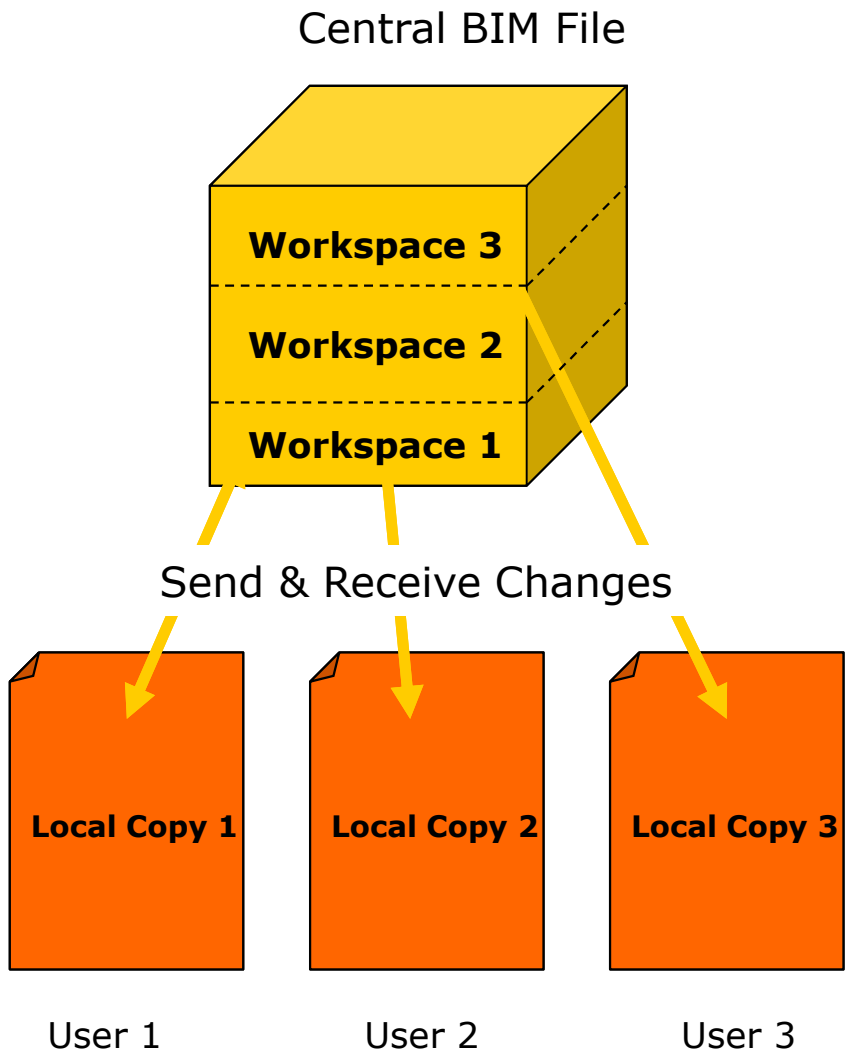
- Quantity takeoffs
- Room Inventories
- Door & Window schedules



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

BIM – Teamwork & Collaboration

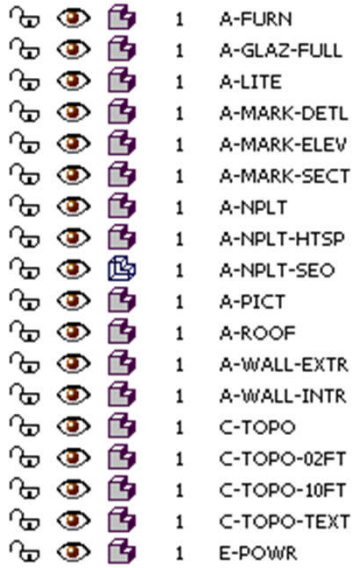
- Teamwork solutions in BIM applications are usually based on the following concept:
  - Central file contains the complete virtual building database
  - Team members work on local copies of the project
  - Team members have dedicated workspaces
  - Team members send and receive changes between the server and their local project copies



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

BIM - AEC CAD standards

- *BS 1192* (British Standards) widely used in the UK
- *AIA CAD Layer Guidelines* is widespread in the U.S.
- *Uniformat* is a U.S. standard for the organization of building elements
- *ISO 13567* International standard, common in Northern Europe



U.S. National CAD Standard (NCS) - layer name format

Discipline			Major Group					Minor Group					Minor Group					Status
A	I	-	W	A	L	L	-	F	U	L	L	-	D	I	M	S	-	N

AEC (UK) CAD Standard - layer name format

Role		Classification				Presentation		Description						View
A	-	G	2	2	-	M	-	F	l	o	o	r	-	Fwd

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

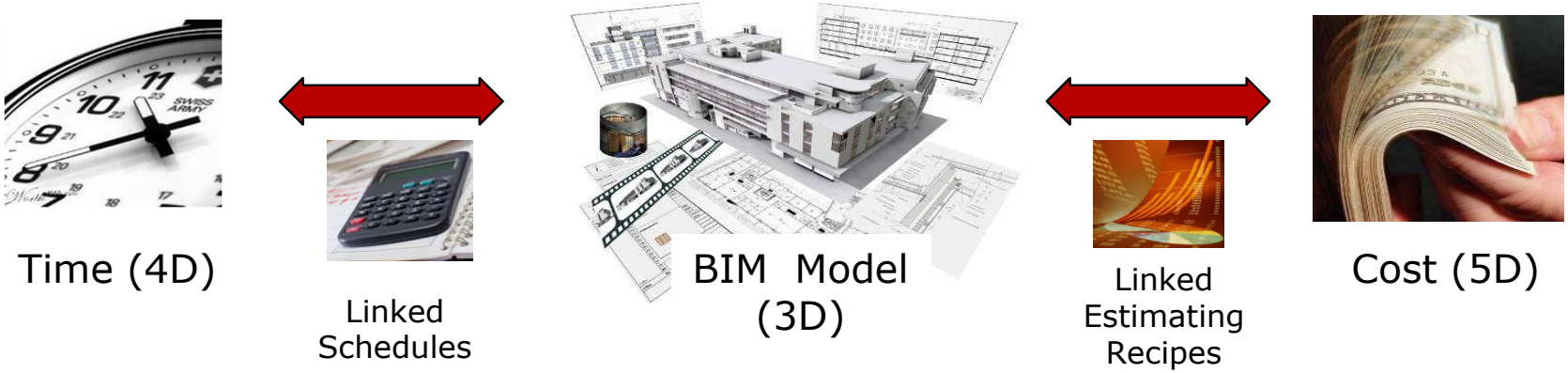
BIM elements and standards

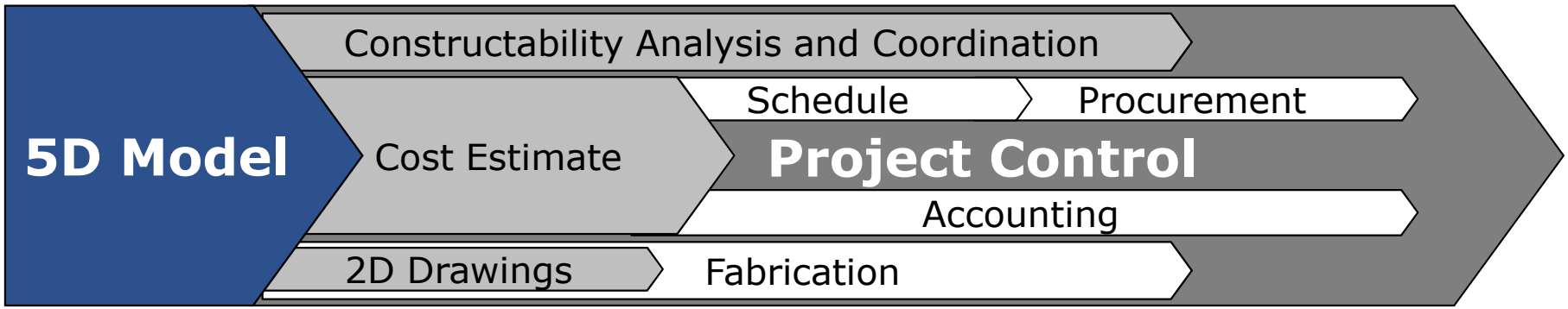
- Common protocols and standards:
  - PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using Building Information Modelling
  - PAS 1192-3 Specification for information management for the operational phase of construction projects using building information modelling
  - Industry Foundation Classes (IFC)
  - COBie (Construction Operations Building Information Exchange)

(See also the links in Building information modelling BIM https://www.designingbuildings.co.uk/wiki/Building_information_modelling_BIM)

Virtual Construction

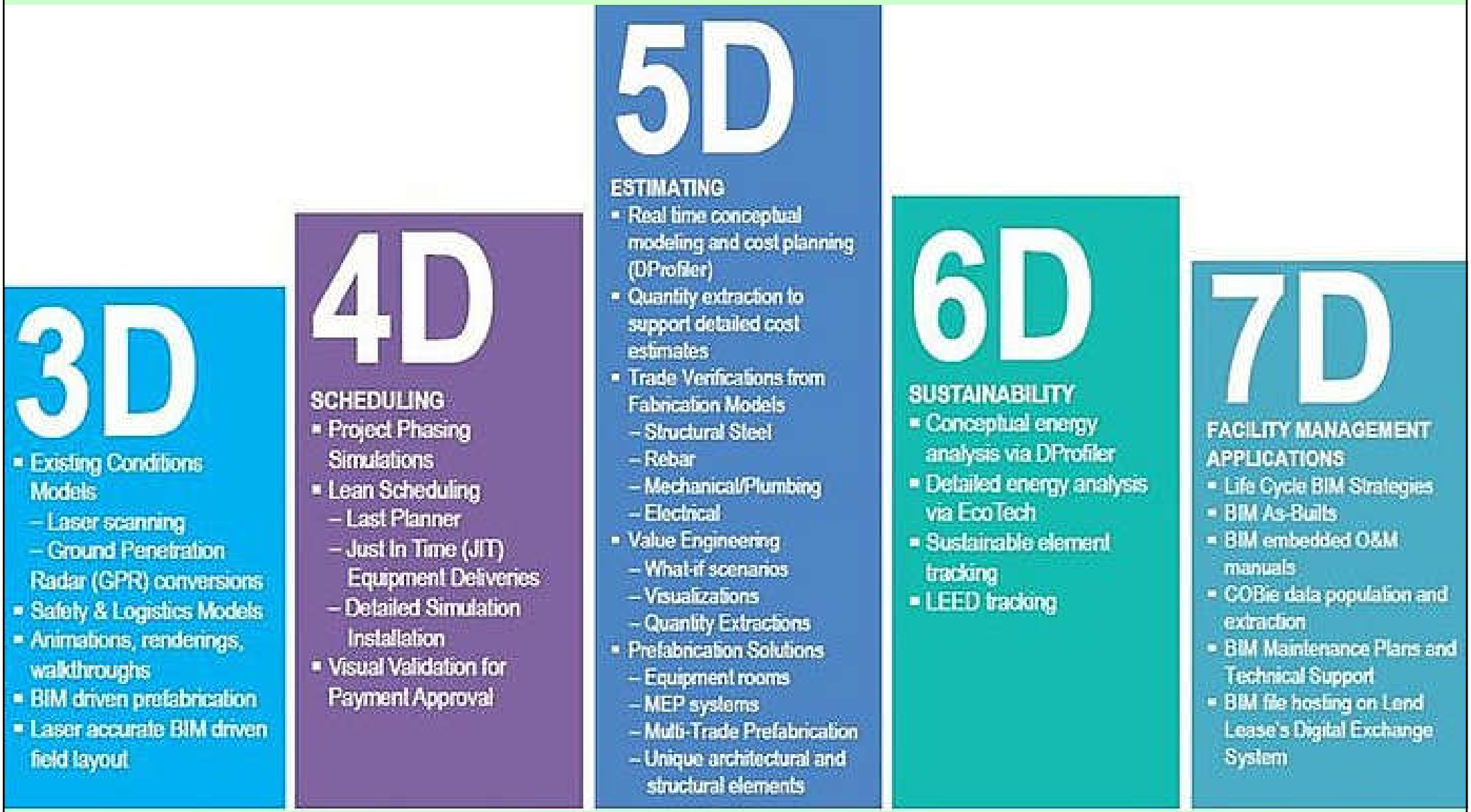
- Construction industry is moving towards automated solutions. Adding time and cost information to the 3D model results the virtual construction model.



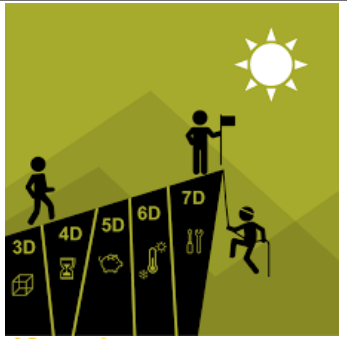


(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

BIM dimensions



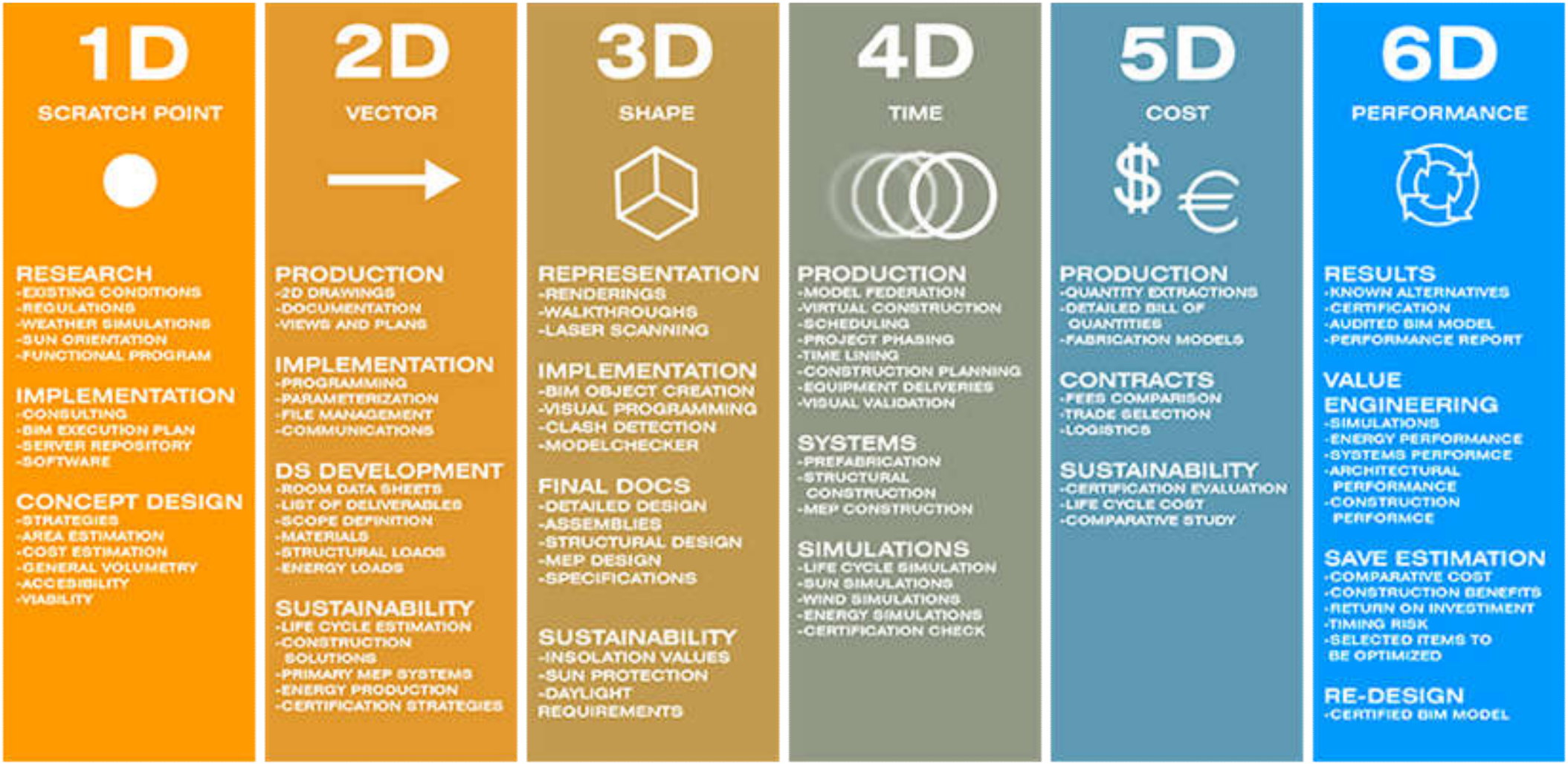
BIM dimensions



- Very broadly, building information includes:
  - 2D
  - 3D
  - 4D (including time / programme information)
  - 5D (including cost information)
  - 6D (including facilities management information)
- Parametric software modelling is used
- The common data environment (CDE) is the single source of information for the project

(Source: Building information modelling BIM https://www.designingbuildings.co.uk/wiki/Building_information_modelling_BIM)

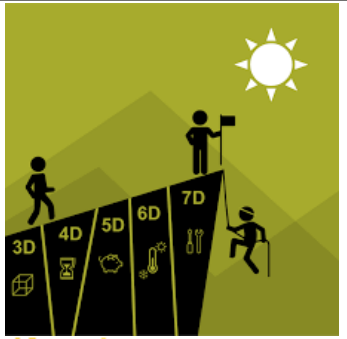
BIM dimensions: 1D to 6D



Note: the 6D is sometimes associated with Facility Management activity or Sustainability.

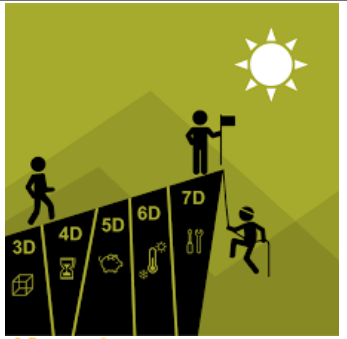
(See also: BIM Dimensions http://data.bim6d.es/bim-dimensions)

BIM dimensions

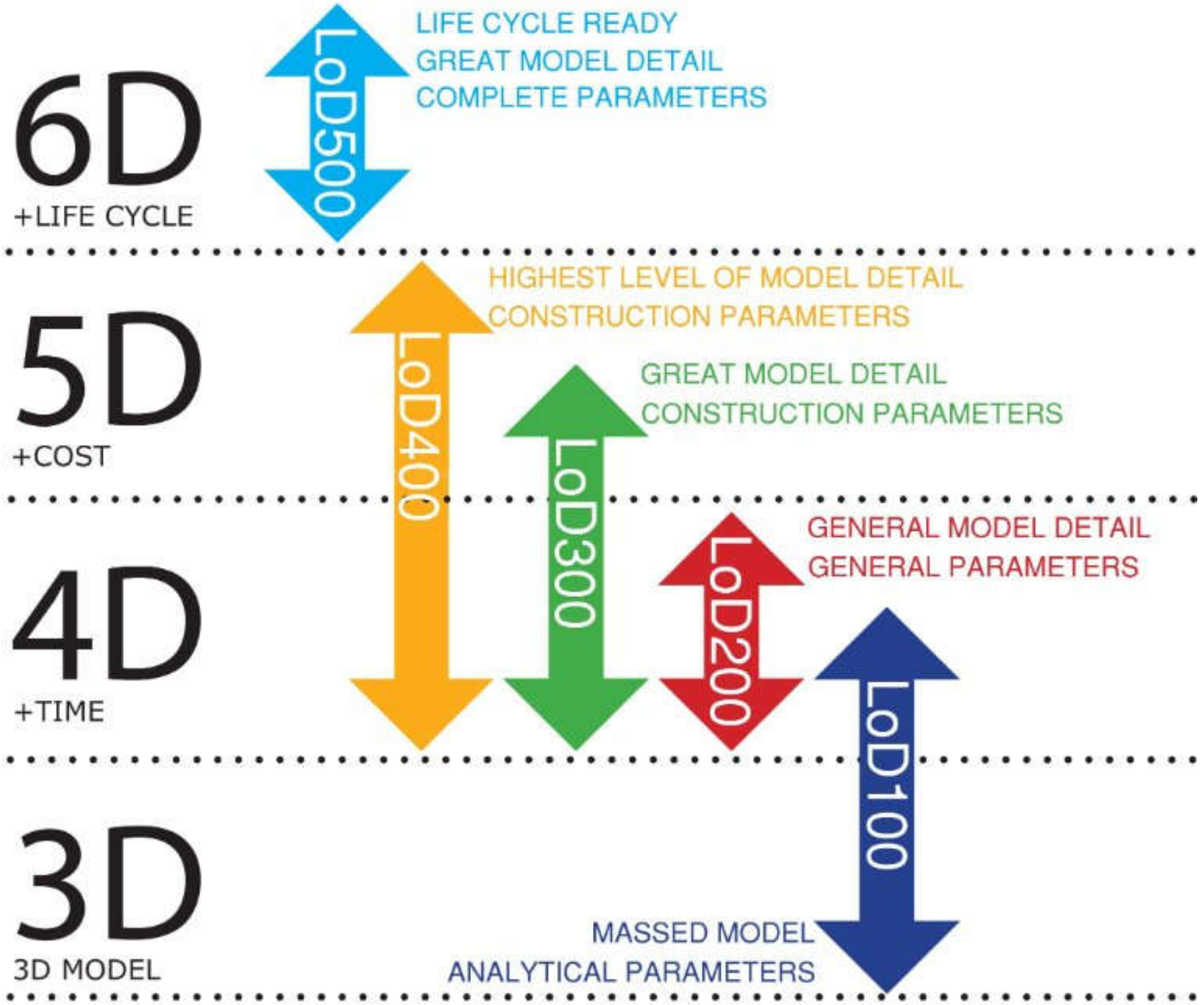


- 3D + Time = 4D Schedule
  - Better communication for construction sequencing
  - Better site planning & logistics
  - Better analysis for project management
  - Uncovers flawed logic in the schedule from visual
- 4D + Quantity + Cost = 5D
  - QTO – Quantity Take Off (in minutes), estimation
  - Spot the difference – track changing variables
  - Auto search & dynamic document of record

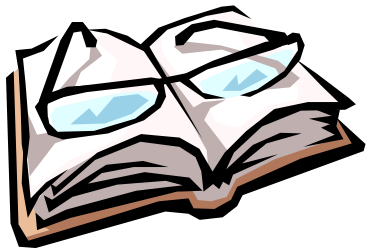
BIM dimensions



- 5D +Facility Information = 6D
  - As-builts are delivered as a Model
  - O&M data – Technical product info – Warranty info – Maintenance schedule/history – All exist in the Model
  - Space utilization tool – Simplify remodels – lease and rental analysis tools
- 7D? or nD? = Sustainability, Safety


6D
+LIFE CYCLE
LoD500
LIFE CYCLE READY
GREAT MODEL DETAIL
COMPLETE PARAMETERS
5D
+COST
LoD400
HIGHEST LEVEL OF MODEL DETAIL
CONSTRUCTION PARAMETERS
LoD300
GREAT MODEL DETAIL
CONSTRUCTION PARAMETERS
4D
+TIME
LoD200
GENERAL MODEL DETAIL
GENERAL PARAMETERS
LoD100
3D
3D MODEL
MASSED MODEL
ANALYTICAL PARAMETERS

Further reading



- Videos:
  - What is BIM: All you need to know (10:36) https://youtu.be/B3Zwm8DNU1c
  - BIM vs. VDC: Is there a difference? (2:40) https://youtu.be/Fcf3hF7bAkI
- BIM For Beginners by The B1M
  - https://www.theb1m.com/BIM-For-Beginners
- Building information modelling BIM
  - https://www.designingbuildings.co.uk/wiki/Building_information_modelling_BIM